EXECUTED BY

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

ONR:603:CAH:bs

CONTRACT NUMBER:	AMENDMENT:	CONTRACT NUMBER:	AMENDMENT:
Nonr-263(01)	11	Nonr-263(05)	6
Nonr-263(02)	8	Nonr-263(07)	1
Nonr-263(04)	8		

The Trustees of the Stevens
Institute of Technology
Hoboken, New Jersey

FEB 1 1955

Gentlemen:

To provide for a new fixed overhead percentage, in accordance with Section 24(a)(7) of Contract Nonr-263(00), to be applied to each of the above-numbered Task Order Contracts for the period set forth below, each of said Task Order Contracts is hereby amended by adding the following to the tabulation under the respective overhead provisions thereof:

"144%	1 October 1954	31 March 1955."

The foregoing makes no change in the estimated cost of any of the above-numbered Task Order Contracts.

Conversion Schedule for the appropriation,
"17X1319 Research and Development, Navy"

Navy - 263(02)

Old Appropriations Symbol and Title		New appropriation Symbol and Title "Research and Development, Navy"
Aircraft and Facilities, Navy	1731502.10	R & D Navy 17X1319.30
	1741502.10	———— .40
Ships and Facilities, Navy	1731601.10	———— .31
	1741601.10	———— .41
Ordnance and Facilities, Navy	1731702.10	———— .32
	1741702.10	———— .42
Medical Care, Navy	1731002.10	———— .33
	1741002.10	———— .43
Civil Engineering, Navy	1731201.10	———— .34
	1741201.10	———— .44
Service-Wide Supply and Finance, Navy	1731803.10	———— .35
	1741803.10	———— .45
Military Personnel, General Expenses	1731413.10	———— .36
	1741413.10	———— .46
Marine Corps. Troops and Facilities	1731106.10	———— .37
	1741106.10	———— .47
Research, Navy	17X1317.10	———— .18
	.20	———— .28
	.30	———— .38
	.40	———— .48
Maintenance and Operation of Research Facilities	.11	———— .49
	.21	———— .49
	.31	———— .49
	.41	———— .49
Installation and Maintenance of Training Equipment	.32	———— .49
	.23	———— .49
	.33	———— .49
	.43	———— .49
Patents	.36	———— .49
	.24	———— .49
	.34	———— .49
	.45	———— .49
Departmental Administration	.15	———— .49
	.25	———— .49
	.35	———— .49
	.45	———— .49

EXECUTED BY BOTH PARTIES

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

ONR:603:CAH:gc

CONTRACT NUMBER:	AMENDMENT:	CONTRACT NUMBER:	AMENDMENT:
Nonr-263(01)	8	Nonr-263(04)	4
Nonr-263(02)	7	Nonr-263(05)	4

The Trustees of the Stevens
Institute of Technology
Hoboken, New Jersey

DEC 15 1953

Gentlemen:

To provide for a new fixed overhead percentage, in accordance with Section 24(a)(7) of Contract Nonr-263(00), to be applied to each of the above-numbered Task Order Contracts for the period set forth below, each of said Task Order Contracts is hereby amended by adding the following to the tabulation under the respective overhead provisions thereof:

"133%	1 October 1953	30 September 1954."

The foregoing makes no change in the estimated cost of any of the above-numbered Task Order Contracts.

EXECUTED BY BOTH PARTIES

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

ONR:603:CAH:bs

CONTRACT NUMBER:	AMENDMENT:	CONTRACT NUMBER:	AMENDMENT:
Nonr-263(01)	5	Nonr-263(04)	3
Nonr-263(02)	6		

The Trustees of Stevens
Institute of Technology
Hoboken, New Jersey

SEP 1 1953

Gentlemen:

To provide for a new fixed overhead percentage, in accordance with Section 24(a)(7) of Contract Nonr-263, to be applied to each of the above-numbered Task Order Contracts for the period set forth below, each of said Task Order Contracts is hereby amended by adding the following to the tabulation under the respective overhead provisions thereof:

"131%	1 October 1952	30 September 1953."

The foregoing makes no change in the estimated cost of any of the above-numbered Task Order Contracts.

SIGNED BY BOTH PARTIES

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

CONTRACT NUMBER: Nonr-263(02)
AMENDMENT NUMBER: 5

ONR:610:CPS:gc
Nonr-263(02)
(Mathematical
Sciences Division)

The Trustees of the
Stevens Institute of Technology
Hoboken, New Jersey

31 JUL 1953

Gentlemen:

Due to a heavy work load on the part of the Contractor's personnel, the editing and printing of the final report of the research under Task Order Nonr-263(02) cannot be furnished within the time specified. In order that the research may be accomplished, it has been determined to extend the period of performance of said Task Order.

In consideration of the foregoing, said Task Order, as amended, is hereby further amended by deleting Section F in its entirety and substituting in lieu thereof the following:

"SECTION F - The performance of work under this Task Order shall commence on 1 March 1951, and shall be completed on 31 October 1953."

This amendment makes no change in the estimated cost of Task Order Nonr-263(02).

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

CONTRACT NUMBER: Nonr-263(02)
AMENDMENT NUMBER: 4
AUTHORITY: NR 341-009/9-23-52
APPROPRIATION: (See last paragraph hereof)
DECREASE: $15,004.00

ONR:262:THT:bs
Nonr-263(02)
(Mathematical Sciences Division)

The Trustees of the
Stevens Institute of Technology
Hoboken, New Jersey

30 APR 1952

Gentlemen:

It is the desire of the Government and the Contractor that the instrumentation phase of the research and investigation of new approaches to the theory and design of automatic controls of improved performances be deleted from Task Order Nonr-263(02) due to the difficulty in employing a subcontractor and that the contract be continued with a more concentrated study on the mathematical phase as set forth in Section A as now amended. To accomplish this, there are hereby provided a decrease in the estimated cost and an increase in the period of performance of said Task Order.

In consideration of the foregoing, said Task Order, as amended, is hereby further amended as follows:

1. At the top of page 1, delete the Estimated Cost in its entirety and substitute in lieu thereof the following:

"ESTIMATED COST: $24,496.00."

2. On and after the date of this amendment, paragraph (3) of Section A shall not apply.

3. Delete Section C in its entirety and substitute in lieu thereof the following:

"SECTION C - The estimated cost of the performance of this Task Order is twenty four thousand four hundred and ninety six dollars ($24,496.00)."

4. Delete Section F in its entirety and substitute in lieu thereof the following:

"SECTION F - The performance of work under this Task Order shall commence on 1 March 1951, and shall be completed on 31 July 1953."

This amendment decreases the total estimated cost of Task Order Nonr-263(02) by $15,004.00, which decrease is credited to Appropriation 17X1317.10 Research Navy (Expenditure Account 46110) (Object Classification 079) Program Number 32000.

CONTRACT NUMBER: Nonr-263(02)
AMENDMENT NUMBER: 4

If the foregoing is acceptable to you, please indicate your acceptance thereof by executing the enclosed two (2) copies of this letter, and return them to the Office of Naval Research, whereupon this letter and your acceptance thereof will constitute this an amendment to the above numbered contract.

Sincerely yours,

Contracting Officer
Office of Naval Research
Department of the Navy

WITNESSES:

(1)_____

(2)_____

NOTE: In the case of a corporation witnesses are not required but certificate below must be completed.

ACCEPTED THE TRUSTEES OF THE STEVENS INSTITUTE OF TECHNOLOGY
(Contractor)

By_____

TITLE_____

CERTIFICATE

I, _____, certify that I am the Secretary of the corporation named as Contractor in the foregoing amendment; that _____, who signed said amendment on behalf of the Contractor was then _____ of said corporation; that said amendment was duly signed for and in behalf of said corporation by authority of its governing body and is within the scope of its corporate powers.

_____
(Signature of person certifying)

(CORPORATE SEAL)

EXECUTED BY BOTH PARTIES

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

CONTRACT NUMBER: Nonr-263(02)
AMENDMENT NUMBER: 3

ONR:262:THT:rch
Nonr-263(02)
(Mathematical Sciences Division)

29 FEB 1952

The Trustees of the
Stevens Institute of Technology
Hoboken, New Jersey

Gentlemen:

To provide the Contractor sufficient time within which to prepare and submit the final report and fulfill all other necessary requirements of the research under Task Order Nonr-263(02), it has been determined to extend the period of performance of said Task Order.

In consideration of the foregoing, said Task Order, as amended, is hereby further amended by deleting Section F in its entirety and substituting in lieu thereof the following:

"SECTION F - The performance of work under this Task Order shall commence on 1 March 1951, and shall be completed on 30 April 1952."

This amendment makes no change in the estimated cost of Task Order Nonr-263(02).

NAVEXOS 2185-17-2 (Rev. 3-51)

CONTRACT NO. Nonr-263(02)

AMENDMENT NO. 3

If the foregoing is acceptable to you, please indicate your acceptance thereof by executing the enclosed two (2) copies of this letter, and return them to the Office of Naval Research, whereupon this letter and your acceptance thereof will constitute this an amendment to the above numbered Task Order.

Sincerely yours,

Contracting Officer
Office of Naval Research
Department of the Navy

ACCEPTED THE TRUSTEES OF THE STEVENS INSTITUTE OF TECHNOLOGY
(Contractor)

By_____

TITLE_____

WITNESSES:

(1)_____

(2)_____

NOTE: In the case of a corporation witnesses are not required but certificate below must be completed.

CERTIFICATE

I, _____, certify that I am the Secretary of the corporation named as Contractor in the foregoing amendment; that _____, who signed said amendment on behalf of the Contractor was then _____ of said corporation; that said amendment was duly signed for and in behalf of said corporation by authority of its governing body and is within the scope of its corporate powers.

_____
(Signature of person certifying)

(CORPORATE SEAL)

EXECUTED BY BOTH PARTIES

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

CONTRACT NUMBER: Nonr-263(02)
AMENDMENT NUMBER: 2

ONR:263:BAT:bs
Nonr-263(02)
(Mathematical Sciences
Division)

The Trustees of the Stevens
Institute of Technology
Hoboken, New Jersey

1 MAY 1952

Gentlemen:

To establish the overhead rate applicable under Task Order Nonr-263(02) for the period from 1 October 1951 to 30 September 1952, in accordance with the provisions of Section 24(a)(7) of the contract, said Task Order, as amended, is hereby further amended by adding the following under the tabulation in Section D thereof:

"133% 1 October 1951 30 September 1952."

This amendment makes no change in the estimated cost of Task Order Nonr-263(02).

NAVEXOS 2185-17-2 (Rev. 3-51)

CONTRACT NO. Nonr-263(02)

AMENDMENT NO. 2

If the foregoing is acceptable to you, please indicate your acceptance thereof by executing the enclosed two (2) copies of this letter, and return them to the Office of Naval Research, whereupon this letter and your acceptance thereof will constitute this an amendment to the above numbered Task Order.

Sincerely yours,

Contracting Officer
Office of Naval Research
Department of the Navy

ACCEPTED THE TRUSTEES OF THE STEVENS INSTITUTE OF TECHNOLOGY
(Contractor)

By _____

TITLE _____

WITNESSES:

(1) _____

(2) _____

NOTE: In the case of a corporation witnesses are not required but certificate below must be completed.

CERTIFICATE

I, _____, certify that I am the Secretary of the corporation named as Contractor in the foregoing amendment; that _____, who signed said amendment on behalf of the Contractor was then _____ of said corporation; that said amendment was duly signed for and in behalf of said corporation by authority of its governing body and is within the scope of its corporate powers.

_____
(Signature of person certifying)

(CORPORATE SEAL)

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D.C.

CONTRACT NUMBER: Nonr-263(02)
AMENDMENT NUMBER: 1

ONR:268:WRM:njl
Nonr-263(02)
(Mathematical Sciences Division)

The Trustees of the Stevens
Institute of Technology
Hoboken, New Jersey

Gentlemen:

To establish the "use" charge applicable under Task Order Nonr-263(02) for the period 1 February 1951 to 30 January 1952, in accordance with the provisions of Section 24(a)(9) of Contract Nonr-263(00), said Task Order Nonr-263(02) is hereby amended by adding the following new Section:

"SECTION G - In accordance with the provisions of subsection 24(a)(9) of the contract, a use charge for the period or periods specified below is hereby established for 'Maddida' special purpose computer equipment for work under this Task Order:

Amount Per Hour Machine Usage	Period for Which Applied From	To
$7.50	1 February 1951	30 January 1952."

This amendment makes no change in the estimated cost of Task Order Nonr-263(02).

"Cancelled"

Record Copy
11/9/51

"Cancelled"

NAVEXOS 2185-17-2 (Rev. 3-5)

CONTRACT NO. Nonr-263(02)

AMENDMENT NO. 1

If the foregoing is acceptable to you, please indicate your acceptance thereof by executing the enclosed two (2) copies of this letter, and return them to the Office of Naval Research, whereupon this letter and your acceptance thereof will constitute this an amendment to the above numbered Task Order.

Sincerely yours,

Contracting Officer
Office of Naval Research
Department of the Navy

ACCEPTED THE TRUSTEES OF THE STEVENS INSTITUTE OF TECHNOLOGY
(Contractor)

By _____

TITLE _____

WITNESSES:

(1) _____

(2) _____

NOTE: In the case of a corporation witnesses are not required but certificate below must be completed.

CERTIFICATE

I, _____, certify that I am the Secretary of the corporation named as Contractor in the foregoing amendment; that _____, who signed said amendment on behalf of the Contractor was then _____ of said corporation; that said amendment was duly signed for and in behalf of said corporation by authority of its governing body and is within the scope of its corporate powers.

_____
(Signature of person certifying)

(CORPORATE SEAL)

Revised
A 20 May 1948

Determination and Findings

Method of Contracting

D&F No. 3971

Upon the basis of the following findings and determinations which I hereby make as a Contracting Officer pursuant to the provisions of Section 7 of the Armed Services Procurement Act of 1947 and authority delegated thereunder, the proposed contract may be entered into on a cost basis, pursuant to the authority of Section 4(b) of said Act, for research and investigation of new approaches to the theory and design of automatic controls of improved performances, with

THE TRUSTEES OF THE STEVENS INSTITUTE OF TECHNOLOGY

FINDINGS

1. The proposed contract has an estimated cost of $ 39,500.00 , without any fixed fee.

2. Negotiation of the proposed contract is authorized under Section 2(c)1 of the Armed Services Procurement Act of 1947.

3. The exact nature and extent of the work covered by the proposed contract, and the precise method of performing that work, cannot be established in advance, but must be freely subject to improvisation and change as the work progresses.

4. The costs of performing the work under the proposed contract cannot be accurately forecast so as to permit the undertaking of such work for a fixed price.

DETERMINATIONS

1. It is impracticable to secure services of the kind or quality required without the use of the proposed type of contract.

2. The estimated cost of the proposed contract is $ 39,500.00

J. B Scatchard

J. B Scatchard
Lieut. Comdr., SC, USN

Contracting Officer
Office of Naval Research
Department of the Navy

1 MAR 1948

EXECUTED BY BOTH PARTIES

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
CONTRACT NUMBER: Nonr-263(02)

RESEARCH AND DEVELOPMENT TASK ORDER 1 MAR 1951

CONTRACTOR: The Trustees of the Stevens Institute of Technology

AUTHORITY: NR 341-009/1-19-51 (Mathematical Sciences Division)

APPROPRIATION: 17X1317.10 Research Navy (Expenditure Account 46110) (Object Classification 079) Program Number 32000

ESTIMATED COST: $39,500.00

This Task Order is established under, and constitutes a part of, Contract Nonr-263(00) which sets forth the basic contract provisions applicable hereto. In case of any conflict between the provisions of said Contract Nonr-263(00) and the provisions hereof, the latter shall control.

SECTION A - The Contractor shall use his best efforts to furnish the necessary personnel and facilities for and, in accordance with any instructions issued by the Scientific Officer or his authorized representative, shall conduct research and investigation of new approaches to the theory and design of automatic controls of improved performances. Such research and investigation shall include, but not necessarily be limited to:

(1) development of the theory of saturated controls obeying non-linear control equations which optimize performance;

(2) iterative predictive schemes in control problems; and

(3) determination of the feasibility of the above approaches to the improvement of automatic control performance.

SECTION B - The Scientific Officer under this Task Order is the Head, Mathematics Branch, Mathematical Sciences Division, Office of Naval Research.

SECTION C - The estimated cost of the performance of this Task Order is thirty nine thousand five hundred dollars ($39,500.00).

SECTION D - The percentage to be applied with respect to this Task Order in accordance with the provisions of Section 24(a)(7) of the contract shall be a fixed percentage, in the amount or amounts, and for the period or periods, specified below:

	Period for which Applied	
	From	To
14%	1 March 1951	30 September 1951.

CONTRACT NUMBER: Nonr-263(02)

SECTION E - The Contractor shall submit final reports upon completion of work hereunder, making full disclosure of all research conducted, and shall submit such other reports as are required by the Scientific Officer.

SECTION F - The performance of work under this Task Order shall commence on 1 March 1951, and shall be completed on 29 February 1952.

CONTRACT NUMBER: Nonr-263(02)

This negotiated Task Order is entered into pursuant to the provisions of Section 2(c)1 of the Armed Services Procurement Act of 1947 (Public Law 413, 80th Congress), and any required determination and findings with respect thereto has been made.

IN WITNESS WHEREOF the parties hereto have executed this Task Order as of the day and year first above written.

UNITED STATES OF AMERICA

BY _____

Contracting Officer
Office of Naval Research
Department of the Navy

WITNESSES:

(1) _____ _____
Contractor

(2) _____ By _____

NOTE: In the case of a corporation witnesses are not required but certificate below must be completed. TITLE _____

_____
(Business address of Contractor)

CERTIFICATE

I, _____, certify that I am the Secretary of the corporation named as Contractor in the foregoing Task Order; that _____, who signed said Task Order on behalf of the Contractor was then _____ of said corporation; that said Task Order was duly signed for and in behalf of said corporation by authority of its governing body and is within the scope of its corporate powers.

_____
(Signature of person certifying)

(CORPORATE SEAL)

nr-263(02)
Ser 6679

THIRD ENDORSEMENT on ANCIinC Newark, N.J. B/O SCI,EA ltr N13(RE) Stevens dtd 17 December 1954

From: Chief of Naval Research
To: OinC, U. S. Navy Regional Accounts Office, Third Naval District, Brooklyn New York
Subj: Contract Nonr-263(02), Stevens Institute of Technology; forwarding of fin voucher in the amount of $1,180.12 and related terminal documents

1. Forwarded to be placed in line for payment, same having been duly certified by the Technical Officer, Mr. S. Ferraris, Office of Naval Research Branch Office, New York, New York.

2. Final technical reporting requirements with respect to the research work performed have been properly fulfilled to the satisfaction of the cognizant Scientific Officer.

3. Proper accounting has been made of all Government-owned property furnished for use under subject contract.

4. Subject Contractor has satisfactorily complied with patent provisions of the contract; therefore, insofar as patent license provisions are concerned, payment of final settlement may be made.

5. Contractor's Release of the Government, conditioned upon the payment of the sum of $24,496.00 , the sum of $23,315.88 having been heretofore paid and the sum of $1180.12 to be paid (represented by Final Voucher), has been reviewed as to form and approved by the Contracting Officer.

6. Proper technical certification of the Final Audit Report for subject contract was made on 8 March 1955 by Dr. Arthur Grad, cognizant Scientific Officer, Office of Naval Research, Washington, D. C.

7. Contractor has complied with Royalties Clause of subject contract, reporting that no royalties have been or are due to be paid during the performance of the contract.

8. After payment of subject voucher, all of the funds appropriated for subject contract will have been paid leaving no unexpended funds under the contract.

9. Original of Enclosure (6) has been returned to Supervisory Cost Inspector, Eastern Area, as requested in Second Endorsement. Enclosures (9) and (10) have been retained for the files of this office.

DUTE SHEET
S 2116 (6-54)

DATE RECEIVED	LOGGED BY	NO.
2/25/55	abw	157231

NAVY
RVISORY COST INSPECTOR, U.S. N.

REF./SERIAL NO.	DOCUMENT DATE
EASTERN AREA	2/25/55

T AND ENCLOSURES
ract Nonr 263(02) w/Stevens Institute of Technology, Hoboken, N.J., Final Audit
rt on---SECOND END. on ANCIinC Newark, N.J. B/O SCI, EA ltr N13(HE)Stevens of
7/55

Basic & Ends w/encls

341-009

PUR-POSE *	RECEIVED DATE	RECEIVED INITIALS	RELEASED DATE	RELEASED INITIALS	COMMENTS (Initial and date)
1	3/1/55				
	3/8/55				HAS A SATISFACTORY FINAL REPORT BEEN REC'D. ? Yes Adj. PLEASE SIGN 2 COPIES OF "CERTIFICATE OF TECHNICAL OFFICER CONTAINED IN FINAL AUDIT REPORT.
	3/9				FINAL PROPERTY CHECK. No Property

Instructions and additional comment space on reverse side.

ORMATION. 3. COMMENT REQUESTED.
NIZANCE. 4. ACTION.
5. SIGNATURE ON PREPARED REPLY.

OT DETACH unless incoming document is offi-
ransmitted to another activity.

CENTRAL MAIL AND FILE ROOM USE.

SUBJECT CLASS NO.	REPLY SERIAL NO.
	6679
	DATE 25 MAR 1955

T4(EH)
Stevens Inst. of Tech.
23 Feb. 1955

SECOND ENDORSEMENT on ANCIinC Newark, N.J. B/O SCI,EA ltr N13(RE)Stevens of 17 December 1954

From: Supervisory Cost Inspector, USN, Eastern Area
To: Office of Naval Research
Washington 25, D. C.

Subj: Contract Nonr 263(02) w/Stevens Institute of Technology, Hoboken, N. J., Final Audit Report on

1. Enclosures (1) through (6) of the basic letter and enclosures (9) and (10) of the first endorsement are forwarded for appropriate action. The Supervisory Cost Inspector has determined the amount of $24,496.00 to be the allowable cost of performing the subject Task Order.

2. Supplementing the information contained in paragraph 2 of the basic letter, overhead was reimbursed at negotiated fixed rates as specified in the contract.

3. Other than the deduction of $12.98 for costs in excess of the contract maximum, no formal or informal disallowances were taken by the Cost Inspector.

4. The Head, Mathematics Branch (Code 432), Office of Naval Research is requested to sign the certificate of the Technical Inspector in enclosure (6) and return the original thereof for the records of this Activity.

J. R. ALLEN

Copy to:
Newark B/O SCI,EA
ONR, NY
CIS(NCT) w/copies of encls of basic ltr and endorsements)
BAO,NY w/basic ltr

15 1954
, U.S.N.

L4-3/3P/ES:es
Nonr-263(02)
Ser 6720
OCT 14 1954

FIRST ENDORSEMENT on SCI, EA, Port Newark, NJ ltr N13(LO) Stevens of 31 Aug 1954 w/encls

From: Commanding Officer, Office of Naval Research, New York
To: Cost Inspection Service (Code NCT), Office of the Comptroller of the Navy, Washington 25, D. C.
Via: (1) Supervisory Cost Inspector, USN, EA
(2) Chief of Naval Research (Code 650)

Subj: Contract Nonr-263(02), Stevens Institute of Technology; Final Audit Report and related terminal documents; forwarding of

Encl: (9) Certificate of Compliance with Contract Patent Provisions dtd 16 Feb 1954 (orig & 4 cys)
(10) Final Property Inventory dtd 9 Dec 1953 (1 cy)

ROUTE STAMP		
Sec.	Act'n.	Info.
SCI		
ADM		
F. SUP	1	
MAT		
TECH		

1. Forwarded for appropriate action.

2. Enclosure (1) has been certified by the cognizant technical representative of this office. The Technical Officer's certificate, enclosure (6), is hereby referred to the Head, Mathematics Branch (Code 432) of the Office of Naval Research for accomplishment.

3. The contractor's patent certificate, enclosure (9), indicating that no inventions were conceived or developed under subject contract, has been approved by the Heads of the Patent and Scientific Departments of this office.

4. This office confirms the contractor's final inventory statement, enclosure (10), that no property was furnished to or acquired by the contractor under subject contract. Consequently, there remains no disposable residual inventory.

5. The contractor was furnished one classified document for use in connection with subject contract. This document was returned to the Office of Naval Research, New York on 7 October 1954. No other classified documents were furnished through this office.

6. The final report under subject contract was forwarded direct to the Chief of Naval Research (Code 432) on 30 November 1953.

7. Enclosure (8) has been retained for the files of this office.

A. SLEDGE

Copy to:
SCI, Port Newark
CNR (432)
CNR (640) w/orig & 4 cys encl (10)

BRANCH OFFICE, SUPERVISORY COST INSPECTOR, USN, EASTERN AREA
NAVAL INDUSTRIAL RESERVE SHIPYARD
BLDG. 13 PORT NEWARK
NEWARK 5, N. J.

N13(RE)Stevens
17 December 1954

From: Acting Navy Cost Inspector-in-Charge, Branch Office, SCI, EA, Newark, N. J.
To: Director, Office of Naval Research
Navy Department
Washington 25, D. C.
Via: Supervisory Cost Inspector, USN, Eastern Area

Subj: Final Audit Report on Contract NOnr-263(02) with Stevens Institute of Technology, Hoboken, N. J.

Encl: (1) Final Public Voucher #25, $1,180.12 (Orig. & 9 copies)
(2) Cumulative Claim and Reconciliation (Orig. & 7 copies)
(3) Affidavit of Waiver of Lien (Orig. & 1 copy)
(4) Contractor's Release of Claims (Orig. & 4 copies)
(5) Assignment of Credits and Refunds (Orig. & 4 copies)
(6) Certificate of Cost Inspector, Supervisory Cost Inspector, and Technical Inspector (Orig. & 4 copies)
(7) Copies of enclosures (1) thru (6) for SCI, EA
(8) Copies of enclosures (1) thru (6) for ONR, New York

1. Contract NOnr-263(02) is a cost-type contract, dated 1 March 1951 and was completed 30 November 1953. Contract required engineering research and development services as specified therein.

2. Allowable costs were determined in accordance with the compensation terms of the contract and Part 3, Section XV, of the Armed Services Procurement Regulations. Audit was made to the extent deemed necessary in the circumstances. No fee was provided for in the contract.

3. Summary of Contract Performance

Summary of Approved Costs

Salaries and Wages - Engineers	$ 7,939.50
Salaries - Staff Consultant	135.00
Materials and Services	5,502.06
Travel Expense	377.35
Engineering Overhead:	

Period	Salary Base	Overhead Rate	Overhead	
Inception to 9/30/51	$ 440.16	142%	$ 625.03	
10/1/51 to 9/30/52	4,495.25	133%	5,978.68	
10/1/52 to 9/30/53	2,203.11	131%	2,886.06	
10/1/53 to 11/30/53	800.98	133%	1,065.30	
	$7,939.50		$10,555.07	10,555.07
Total Costs				$24,508.98
Less: Excess of Contract Maximum				12.98
Total Approved Costs				$24,496.00

Subj: Final Audit Report on Contract NOnr-263(02) with Stevens Institute of Technology, Hoboken, N. J.

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4. Reimbursed by Navy

Vouchers Nos. 1 to 24	$23,315.88
Final Public Voucher No. 25	1,180.12
	$24,496.00

Total Estimated Cost as amended $24,496.00

5. The Contractor's costs are subject to project audit by the General Accounting Office and all required documentary evidence in support of direct charges approved for payment is available at the Branch Office of the Supervisory Cost Inspector, Eastern Area, Newark, N. J. To date no audit has been made of the total cost. In this connection, the U. S. Regional Accounts Office has been advised that in the opinion of the Navy Cost Inspector, none of the approved costs are likely to become the subject of an uncleared General Accounting Office Notice of Exception.

6. It is understood from the Office of Naval Research, New York, that there is no terminal inventory or government-furnished property or property acquired for the account of the government.

7. The cognizant Technical Inspector is requested to execute the certificate on enclosure (6).

8. It is understood from the Office of Naval Research, New York, that the Contractor has complied with the provisions of the contract relating to patents.

9. There are no known potential credits and refunds. In this connection, the contractor has executed an Assignment of Credits and Refunds (enclosure (5)). In addition the contractor has furnished a Release of Claims which is forwarded as enclosure (4) hereof.

ANTHONY P. PEDUTO

Form No. 1034a—Revised (7M)
Form prescribed by
Comptroller General, U. S.
September 7, 1950
(Reg. No. 51, Supp. No. 11)
(Amended February 20, 1952)

PUBLIC VOUCHER FOR PURCHASES AND SERVICES OTHER THAN PERSONAL

FINAL

D. O. Vou. No. _____

Bu. Vou. No. 25

Department of the Navy - Office of Naval Research
(Department, bureau, or establishment)

PAID BY

prepared at Hoboken, New Jersey 15 February 1954
(Give place and date)

TED STATES, Dr., Payee's Account No. _____

Trustees of the Stevens Institute of Technology
(Payee)

Hoboken, New Jersey
(Address) (City) (State)

ate of r	Date of Delivery or Service	ARTICLES OR SERVICES (Enter description, item number of contract or Federal supply schedule, and other information deemed necessary) Discount Terms	QUANTITY	UNIT PRICE Cost	UNIT PRICE Per	AMOUNT Dollars	AMOUNT Cts.
	1 Nov. to 30 Nov. 1953	24a2 Salaries				509	56
		24a7 Overhead - 133%	677.71				
		" Adj. - 2% of Oct. Salaries					
		$291.42 - additional	5.83			683	54
		Overexpended on contract			Credit	(12	98)
		Use continuation sheet(s) if necessary					
m	to	Weight Government B/L No.			Total	1180	12

(Payee must NOT use this space)

stees of the Stevens Institute of Technology

Differences _____

H. Memory, Treasurer Louis Russo, Bursar

Amount verified; correct for _____
(Signature or initials) _____

o. NOnr-263(02) Date 3/1/51 Req. No. Date Invoice Rec'd.

MEMORANDUM

Technical Officer's certification on reverse side

ACCOUNTING CLASSIFICATION

Appropriation Symbol and Sub-head	Object Class	Expenditure Account	Chargeable Activity	Bureau Control Activity No.	Bureau Control No.	Amount
7.10						
-46110						
m No. 32000						

Project Order Date

heck No. _____ dated _____, 19____, for $_____ { on Treasurer of the United States in favor of payee named above.

ash, $_____, on _____, 19____.

16—22900a-2

METHOD OF OR ABSENCE OF ADVERTISING

METHOD OF ADVERTISING

rtising in newspapers Yes ☐ No ☐

dvertising by circular letters sent to .... dealers.

nd by notices posted in public places Yes ☐ No ☐.

(If notices were not posted in addition to advertising by circular letters sent to dealers, explanation of such omission must be made below.)

ABSENCE OF ADVERTISING

out advertising, under an exigency of the service which existed prior to the order and would not admit of the delay incident to ertising.

out advertising in accordance with ....

out advertising, it being impracticable to secure competition because of ....

I hereby certify that I have examined this public voucher and that to the best of my knowledge and belief, the items for which reimbursements are claimed as listed thereon or on the contractor's invoice attached thereto, are reasonable and were necessarily incurred in the performance of the work under the contract mentioned on said voucher, the contractor performed the services stated, and the contractor is not now in default under said contract in furnishing reports, disclosures, licenses, equipment, papers, or any other tangible articles required under the terms of the contract to be furnished by the contractor within a stated period of time or on a specified date.

S. FERRARIS
ONR Representative

(Here state in detail the nature of the exigency or circumstances under which the securing of competition was impracticable under ...)

OCT 1 1954

E.—The above form "Method of or Absence of Advertising" is to be used when purchases are made or services secured under uthority without written agreement in any form. In case of a written agreement (formal contract, proposal, and acceptance, or al agreement) Standard Form No. 1036—Revised should be used for abstracting the method of or absence of advertising and contract. (See General Regulations No. 51, as amended.)

16—22900—2 U. S. GOVERNMENT PRINTING OFFICE

Costs previously submitted on Vouchers numbered 1 – 24 aggregating $23,315.88 and provisionally approved for $23,315.88 have now been audited and approved for $23,315.88. Voucher No. 25 for $1,180.12 has been (audited and approved) ~~(reviewed and provisionally approved)~~ for $1,180.12. Adjustments of $ — on Vouchers numbered — and $ — On Voucher No. — are detailed on DD Form 396 No. —.

AUG 31 1954
Date

Anthony P. Pedulla
Navy Cost Inspector

J. R. ALLEN, LCDR SC USNR
Supervisory Cost Inspector,
USN, Eastern Area

THE TRUSTEES OF THE
STEVENS INSTITUTE OF TECHNOLOGY
HOBOKEN, NEW JERSEY

EXPERIMENTAL TOWING TANK

Date 9 March 1954

Test No.

To Department of the Navy
Office of Naval Research
Office of the Comptroller of Navy
Cost Inspection Service
Newark 5, New Jersey

Your Order No.

Contract No. NOnr-236(02)

Cumulative Claim and Reconciliation

	Total Claimed	Adjustments	Amount Claimed
Total Claimed from Inception of work under this contract.			
Costs			
Material	5502.06	---	5502.06
Salaries	7939.50	---	7939.50
Salaries - Staff Consultants	135.00	---	135.00
Travel	377.35	---	377.35
Overhead	10555.07	---	10555.07
Total Costs	24508.98	---	24508.98
Overexpended on contract	12.98	---	12.98
Total	24496.00	---	24496.00
Less: Amounts Approved on Public Vouchers Nos. 1 to 25 *	---		---
*Includes Final Voucher			
Items Disallowed	---		---

I Certify that the above figures have been taken from the records of The Trustees of the Stevens Institute of Technology and are correct to the best of my knowledge and belief.

The Trustees of The Stevens Institute of Technology

Nichol H. Memory, Treasurer

Date: 10 March 1954

CONTRACTOR'S RELEASE UNDER CONTRACT Nonr-263(02)

KNOW ALL MEN BY THESE PRESENTS: In consideration of the premises and the sum of Twenty Four Thousand Four Hundred Ninety Six and 00/100 Dollars ($24496.00) lawful money of the United States of America (hereinafter called the "Government"), of which Twenty Three Thousand Three Hundred Fifteen and 88/100 Dollars ($23315.88) has already been paid and Eleven Hundred Eighty and 12/100 Dollars ($1180.12) of which is to be paid by the Government under the above mentioned contract in final settlement of all amounts due under said contract, the undersigned contractor does, and by the receipt of said sum shall, for itself, its successors and assigns, remise, release, and forever discharge the Government, its officers, agents and employees, of and from all liabilities, obligations and claims whatsoever in law and in equity under or arising out of aforementioned said contract.

IN WITNESS WHEREOF, This release has been duly executed this 15th day of February 1954.

The Trustees of the Stevens Institute of Technology
(Contractor)

By _____
Nichol M. Memory

Title Treasurer

CERTIFICATE

I, Waldo Shumway, certify that I am the Secretary of the Corporation named as contractor in the foregoing release, that Nichol M. Memory who signed said release on behalf of the contractor was then Treasurer of said corporation; that said release was duly signed for and in behalf of said corporation by authority of its governing body and is within the scope of its corporate powers.

_____
Waldo Shumway

CORPORATE SEAL

ASSIGNMENT OF CREDITS AND REFUNDS

KNOW ALL MEN BY THESE PRESENTS:

That the Trustees of the Stevens Institute of Technology, (hereinafter called the contractor), a Corporation organized and existing under the laws of the State of New Jersey and having its principal place of business at Hoboken, New Jersey, in consideration of the reimbursement for all costs incurred and paid for under the terms of Contract Nonr-263(02) does hereby:

(1) Assign, transfer, set over and release to the United States of America (hereinafter called the Government), all right, title and interest to all refunds, rebates, credits or other amounts now due or which may become due under the said contract together with all rights of action accrued or which may hereinafter accrue thereunder.

(2) Agree to take whatever action may be necessary to effect prompt collection of all refunds, rebates, credits or other amounts due or which may become due, and to promptly forward, or cause to be forwarded directly to the Navy Department, Bureau of Supplies and Accounts, certified checks (made payable to the Treasurer of the United States) for any proceeds so collected.

(3) Agree to cooperate fully with the Government in pursuance of any claim or suit in connection with credits or refunds due; to execute any protests, pleadings, applications, claims, powers of attorney or other papers in connection therewith; and to permit the Government or the Government's attorneys to represent it at any hearing, trial or other proceeding arising out of such claim or suit.

IN WITNESS WHEREOF, said Corporation has caused these presents to be signed in its name, by its Treasurer, this 15th day of February 1954.

The Trustees of the Stevens Institute of Technology
(Contractor)

_____

Michol R. Memory, Treasurer

CERTIFICATE OF NAVY COST INSPECTOR

The undersigned hereby certify that the contractor's books records and original evidences of cost pertaining to contract NOnr-263(02) have been audited in accordance with the instructions of the Comptroller of the Navy and that as a result of such audit it has been determined that the amount of $24,496.00 represents the proper allowable cost of performing said contract in accordance with the terms thereof. No fee was payable under the terms of the contract.

DEC 17 1954
Date

Anthony P. Peduto, Acting Navy Cost Inspector-in-Charge, Branch Office, SCI - Eastern Area
Newark, New Jersey

CERTIFICATE OF SUPERVISORY COST INSPECTOR

The undersigned, acting for and in behalf of the Office of the Comptroller of the Navy (Cost Inspection Service), which has been designated to determine the cost of performing contract NOnr-263(02), hereby certifies that the amount of $24,496.00 has been determined to be the proper allowable cost of performing said contract in accordance with the terms thereof. No fee was payable under the terms of the contract.

FEB 23 1955
Date

J. R. ALLEN, LCDR, SC, USNR
Supervisory Cost Inspector, Eastern Area

CERTIFICATE OF TECHNICAL INSPECTOR OF OFFICE OF NAVAL RESEARCH

The undersigned hereby certifies that the research and development services performed by Stevens Institute of Technology at a reported cost of $24,496.00 fully comply with all technical requirements applicable to contract NOnr-263(02) including all applicable regulations and instructions of the Office of Naval Research and that said contract has been fully and satisfactorily completed.

3/8/55
Date

/s/ ARTHUR GRAD
ONR - CODE 432
MATHEMATICS BRANCH

EXPERIMENTAL TOWING TANK
STEVENS INSTITUTE OF TECHNOLOGY
711 HUDSON STREET HOBOKEN, NEW JERSEY
TELEPHONE HOBOKEN 3-8080

KENNETH S. M. DAVIDSON, DIRECTOR
HUGH W. MACDONALD, DEPUTY DIRECTOR

ASSISTANT DIRECTORS
JOHN B. DRISKO
W. C. HUGLI, JR.

ASSISTANT DIRECTORS
GEORGE R. MORRIS
ALLAN B. MURRAY

16 February 1954

Department of the Navy
Office of Naval Research
Washington 25, D. C.

VIA: Office of Naval Research
346 Broadway
New York 13, New York

ATTENTION: Mr. Elias Soren

SUBJECT: Contract No. Nonr 26302

Gentlemen:

In accordance with the terms of the subject contract please be notified that no patent applications have been or will be made and no inventions have been developed or reduced to practice during and as a result of performance thereunder, and that no royalties or royalty rates have been paid and to the best of our knowledge and belief none is to be paid.

Very truly yours,

STEVENS INSTITUTE OF TECHNOLOGY
EXPERIMENTAL TOWING TANK

George R. Morris

GRM:ms

Approved: Roderick B. Jones
Roderick B. Jones
Head, Patents Department

Approved: Saul Berman
Saul Berman
Head, Scientific Department

Encl (9)

EXPERIMENTAL TOWING TANK
STEVENS INSTITUTE OF TECHNOLOGY
HOBOKEN, NEW JERSEY

16 February 1954

Department of the Navy
Office of Naval Research
Washington 25, D. C.

VIA: Office of Naval Research
346 Broadway
New York 13, New York

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Very truly yours,

STEVENS INSTITUTE OF TECHNOLOGY
EXPERIMENTAL TOWING TANK

GRM:ms

George R. Morris

Approved: Roderick B. Jones
Roderick B. Jones
Head, Patents Department

Approved: Saul Berman
Saul Berman
Head, Scientific Department

c o p y

EXPERIMENTAL TOWING TANK

Stevens Institute of Technology
711 Hudson Street Hoboken, New Jersey

Telephone HOboken 3-8080

Kenneth S. M. Davidson, Dirdctor
Hugh W. MacDonald, Deputy Director

Assistant Directors
John B. Drisko
W. C. Hugli,Jr.

Assistant Directors
George R. Morris
Allan B. Murray

16 February 1954

Department of the Navy
Office of Naval Research
Washington 25, D. C.

VIA: Office of Naval Research
346 Broadway
New York 13, New York

ATTENTION: Mr. Elias Soren

SUBJECT: Contract No. Nonr 26302

Gentlemen:

In accordance with the terms of the subject contract please be notified that no patent applications have been or will be made and no inventions have been developed or reduced to practice during and as a result of performance thereunder, and that no royalties or royalty rates have been paid and to the best of our knowledge and belief none is to be paid.

Very truly yours,

STEVENS INSTITUTE OF TECHNOLOGY
EXPERIMENTAL TOWING TANK

/s/ George R. Morris

George R. Morris

GRM:ms

Approved: Roderick B. Jones
Roderick B. Jones
Head, Patents Department

Approved: Saul Berman
Saul Berman
Head, Scientific Department

c o p y

EXPERIMENTAL TOWING TANK

Stevens Institute of Technology
711 Hudson Street Hoboken, New Jersey

Telephone HOboken 3-8080

Kenneth S. M. Davidson, Director
Hugh W. MacDonald, Deputy Director

Assistant Directors
John B. Drisko
W. C. Hugli, Jr.

Assistant Directors
George R. Morris
Allan B. Murray

16 February 1954

Department of the Navy
Office of Naval Research
Washington 25, D. C.

VIA: Office of Naval Research
346 Broadway
New York 13, New York

ATTENTION: Mr. Elias Soren

SUBJECT: Contract No. Nonr 26302

Gentlemen:

In accordance with the terms of the subject contract please be notified that no patent applications have been or will be made and no inventions have been developed or reduced to practice during and as a result of performance thereunder, and that no royalties or royalty rates have been paid and to the best of our knowledge and belief none is to be paid.

Very truly yours,

STEVENS INSTITUTE OF TECHNOLOGY
EXPERIMENTAL TOWING TANK

/s/ George R. Morris

GRM:ms George R. Morris

Approved: Roderick B. Jones
Roderick B. Jones
Head, Patents Department

Approved: Saul Berman
Saul Berman
Head, Scientific Department

EXPERIMENTAL TOWING TANK
STEVENS INSTITUTE OF TECHNOLOGY
HOBOKEN, NEW JERSEY

9 December 1953

Office of Naval Research
Department of the Navy
346 Broadway
New York 13, New York

ATTENTION: Mr. S. Ferraris

SUBJECT: Contract No. Nonr 26302

Gentlemen:

Please be advised that no capital property was developed or otherwise acquired during the performance of the subject contract and no other materials of any nature were purchased and charged to the contract.

Very truly yours,

STEVENS INSTITUTE OF TECHNOLOGY
EXPERIMENTAL TOWING TANK

GRM:ms

George R. Morris

Encl (10)

FORM NO. 64
3/3P/Nonr-263(02)/St ns Inst. of Tech./SF:mb

Office Memorandum • UNITED STATES GOVERNMENT

: Officer in Charge
U. S. NRAO, U.S. Naval Supply Activities
3rd Ave. & 29th St., Bklyn

DATE: 16 December 1954

:
Head, Contract Admin. Dept.
Office of Naval Research, 346 Broadway, New York

T: Contract Nonr-263(02) with Stevens Inst. of Technology

(a) NRAO ltr FD-110:BV dtd 10 Dec 1954

ne final public voucher was forwarded to NRAO via Code 650 ONR, Washington,
/14/54. By copy this memorandum Code 650 is requested to expedite
ssion of the final voucher to the NRAO.

S. FERRARIS

/ to: Code 650, ONR Wash.

650

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izant Section of ONR	1 copy

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STEVENS INSTITUTE OF TECHNOLOGY
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KENNETH S. M. DAVIDSON, DIRECTOR
HUGH W. MACDONALD, DEPUTY DIRECTOR

ASSISTANT DIRECTORS
JOHN B. DRISKO
W. C. HUGLI, JR.

ASSISTANT DIRECTORS
GEORGE R. MORRIS
ALLAN B. MURRAY

31 August 1953

Office of Naval Research
Washington 25, D. C.

ATTENTION: Code 655

SUBJECT: Contract No. Nonr 26302, Amendment No. 5

Gentlemen:

We enclose herewith (2) executed copies of the subject instrument which extends the period of performance through 31 October 1953.

It is requested that we be provided with (2) conformed copies of the above amendment for our records.

Very truly yours,

STEVENS INSTITUTE OF TECHNOLOGY
EXPERIMENTAL TOWING TANK

George R. Morris

GRM:ms
Encl.
cc: SCI-Newark
ONR-New York

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

NUMBER: Nonr-263(02)
NUMBER: 5

ONR:610:CPS:gc
Nonr-263(02)
(Mathematical
Sciences Division)

:ees of the
Institute of Technology
New Jersey

1:

heavy work load on the part of the Contractor's personnel, the editing and
of the final report of the research under Task Order Nonr-263(02) cannot be
l within the time specified. In order that the research may be accomplished,
:en determined to extend the period of performance of said Task Order.

leration of the foregoing, said Task Order, as amended, is hereby further
)y deleting Section F in its entirety and substituting in lieu thereof the
5:

'TION F - The performance of work under this Task Order shall commence on
1951, and shall be completed on 31 October 1953."

ıdment makes no change in the estimated cost of Task Order Nonr-263(02).

CONTRACT NEGOTIATION DATA
NAVEXOS-3596

Contractor:	Amount
Stevens Institute of Technology, Hoboken, New Jersey	$ -----

R Number	Contract No.	T. O. No.	Amend. No.	Document to be dated:
41-009	Nonr-26302	---	5	31 July 1953

xempt from Int.Rev.Code:	X Yes	No	
edetermination:	Yes	X No	
rogress Payments:	Yes	X No	
dvance Payments:	Yes	X No	
ermination:	Yes	X No	
ew Ending Date	31 October 1953		
mall Business - With:	Yes	X No	
Susceptible to:	Yes	X No	
llar Amount being subcontracted:	$ None		
llar Volume being subcontracted to small business:	$ None		
nnual Rate	-----		

(Check One)

Type of Contract:

		For:	
A	X	Research (Reports)	X
B			
C			
D		Development of Training Devices	
E			
F			
G			
H		Scientific Equip.	
T			
K			
L		Other (state)	
Other			

dministrative Office:	Local Administrator
ew York X	3rd 27
oston	
hicago	
an Francisco	
asadena	
outheastern Area	
nsMat	
AR	
upShips	
ther	

Type of Organization:

Educational	X
Non-profit	
Commercial	
Gov't. Order	
Project Order	
Other	

NO		YES
	Statement from Contractor re use of a company or person to solicit	X
	Have ☐ Have Not ☒	
X	Planned Producer	
X	Planned Item	
X	Contracting Officer's Statement	
X	Business Clearance (Navexos-2760)	
X	Method of Contracting D & F (cost)	
X	Government Furnished Material	
X	Renegotiation applicable to these funds	
X	Naval Working Fund	
X	Classified: Restricted ☐ Confidential ☐ Secret ☐	
X	Subject to Vinson-Trammel Act	
X	Subject to Walsh-Healey Act	
X	Facilities Clearance	

Authority under A. S. P. R. No Cost

If authority other than A. S. P. R., state:

8/24

C. P. Schaff
(Negotiator)
C. P. Schaff

8-13

INTER-OFFICE ROUTE SHEET
S-3067

Contractor: Stevens Institute of Technology, Hoboken, New Jersey
Contract No.: Nonr-263(02)
Task Order No.: **
Amendment No.: 5

DATE
5 August 1953

FROM CODE
610- G

ATOR'S COMMENTS The following information should be forwarded to the Administering Office:

(1) Clearance Memorandum Not required

(2) Other (Indicate)

e)	PUR-POSE	DATE	INITIAL	REMARKS
A (West) E (East)		8/7		
M		8/12/53		
J		8/12/53		
		8/19/53		
-G Recorded: Ex:		8/19	Out:	Proofed: Typed 8-21-53 Read By: Page Checked: 8/21
		8-21-53		
		8/24		
		8/24		
				(Report of Obligation) No Costs Extension
		7/31/53		

for Additional Routing / rpose Designation | 2-Info & Return | 3-Prepare Reply | 4-Necessary Action | 5-Memo Comment | 6-Guidance | 7-Compliance | 8-Retain Encl. | 9-Retain Copy

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

TRACT NUMBER: Nonr-263(02)
NDMENT NUMBER: 5
~~HORITY: NR 341-009/7-28-53~~

ONR:610:CPS
Nonr-263(02)
(Mathematical Sciences)

Trustees of The
vens Institute of Technology
oken, New Jersey

division (B)

tlemen:

to ~~circumstances of~~ a heavy work load on the part of the Contractor's personnel, editing and printing of the final report of the research of Contract Nonr-263(02) not be furnished within the time specified. In order that the research may be omplished, it has been determined to extend the period of performance of said k Order.

consideration of the foregoing, said Task Order, as amended, is hereby further nded by deleting Section F in its entirety and substituting in lieu thereof the lowing:

"SECTION F - The performance of work under this Task Order shall commence 1 March 1951, and shall be completed on 31 October 1953."

s amendment makes no change in the estimated cost of Task Order Nonr-263(02).

Benjamin Lefson
ntific Officer

C. P. Schaff, Negotiator

NT JUSTIFICATION — OFFICE OF NAVAL RESEARCH — RESTRICTED

34 (7-51)

SECTION I - BASIC DATA

TING AGENCY - BRANCH AND CODE: tics - 432

2. SECURITY CLASSIFICATION OF TASK: Unclassified

3. DATE: 7-28-53

IR

5. CONTRACT NO.: Nonr-26302 (05)

7. (A) PROJECT NO. NR: 342-000

(B) OPERATIONAL REQUIREMENTS NO.: ~~NR 1670~~ AD 09401

E OF TASK: Study of Automatically

DDRESS OF CONTRACTOR TO PERFORM WORK: Institute of Technology

, NJ

(C) PROJECT TITLE (If task contributes to two or more projects, list projects and explain, if necessary): Research on the use of Digital Computer Techniques in

8. THIS TASK SUPPORTS OPERATIONAL REQUIREMENTS

INVESTIGATOR(S)

Davidson

PARTICIPATING SCIENTISTS

GRADUATE STUDENTS: 1

SUPERVISOR (Name and code): 1

14. INDICATE WHICH OF FOLLOWING APPLIES TO THIS TASK

- ☐ NEW
- ☐ ACCELERATION
- ☐ RENEWAL
- ☒ NO FUNDS EXTENSION
- ☐ OVER-RUN

ATING BRANCHES (Financial support only): Amin Jansen

15. ESTIMATED COMPLETION DATE OF TASK: 31 October 1953

16. ESTIMATED DURATION (This commitment of funds)

FROM: 1 Aug 1953 TO: 31 Oct 1953

E OF FUNDS FOR THIS COMMITMENT

	AMOUNT OF COMMITMENT	FY
	None	
IES		

s are transferred FROM another source
l out Supplement A (NAVEXOS-3235).
s are to be transferred to another
gency to make this contract, name
,
t Supplement B (NAVEXOS-3235).

19. FOR FISCAL DIVISION USE ONLY

APPROPRIATION	AUTHORIZATION NO.	PROGRAM OR CONTROL NO.	EXPENDITURE ACCOUNT	OBJECT CLASS

FUNDS COMMITTED

AMOUNT

DATE

BY

ACCOUNTING CLASSIFICATION

- ☐ FORMAL OBLIGATION
- ☐ INFORMAL OBLIGATION

COMMITMENTS OF FUNDS ALREADY MADE AND/OR PLANNED

FY	ONR	ALL OTHERS		FY	ONR	ALL OTHERS
1953	$ 24,496	$	CURRENT		$	$
			FUTURE			
			FUTURE			

SECTION II - APPROVAL

BY

ARTHUR GRAD, Acting (Head)

BRANCH

DIVISION: Mathematical Sciences

DATE: 7-29-53

A REES (Director)

MITTEE

DATE

ASSISTANT CHIEF FOR RESEARCH

DATE

(Over)

RESTRICTED

K-3

OFFICE OF NAVAL RESEARCH, NEW YORK
346 BROADWAY
NEW YORK 13, NEW YORK

ADDRESS REPLY TO
DIRECTOR
AND REFER TO:

L4-3/1N/SF:cm
Nonr-263(02)
Ser 5492
14 July 1953

From: Director, Office of Naval Research, New York
To: Chief of Naval Research (Code 650)

Subj: Contract Nonr-263, Task Order 2, Stevens Institute of Technology, Hoboken, New Jersey

Encl: (1) Orig & 3 copies Stevens Inst. ltr /s/ G. R. Morris dated 10 July 1953 to ONR Wash, via ONR NY

1. The contractor's request for a no-cost extension of subject contract from 31 July 1953 to 30 September 1953, in order to complete the final report, is forwarded herewith as Enclosure (1), with recommendatinn for favorable action.

2. The following cost data is furnished for your information:

a.	Expended/Obligated as of 30 June 1953	$21,785.70
b.	Anticipated Expenditures during July	1,299.00
c.	Anticipated Expenditures during August	699.00
d.	Total Expended/Obligated by 31 August	$23,783.70
e.	Anticipated Balance 31 August	$712.30

The contractor has advised that it is unable to estimate the amount required during the month of September to complete the report, except to state that it is certain that the maximum amount of the contract, $24,496 will not be exceeded. A small surplus of approximately $200 may be expected.

BOB O. MATHEWS

EXPERIMENTAL TOWING TANK

STEVENS INSTITUTE OF TECHNOLOGY

711 HUDSON STREET HOBOKEN, NEW JERSEY

TELEPHONE HOBOKEN 3-8080

KENNETH S. M. DAVIDSON, DIRECTOR

HUGH W. MACDONALD, DEPUTY DIRECTOR

ASSISTANT DIRECTORS
JOHN B. DRISKO
W. C. HUGLI, JR.

ASSISTANT DIRECTORS
GEORGE R. MORRIS
ALLAN B. MURRAY

10 July 1953

Office of Naval Research
Department of the Navy
Washington 25, D. C.

Via: Office of Naval Research
346 Broadway
New York 13, New York

Subject: Contract Nonr-263(02)

Gentlemen:

The period of performance of the subject contract expires on 31 July 1953. While writing of the report is almost completed, it now appears that editing and printing may take some additional time due to the heavy work load. Request is therefore made for a two month no cost extension through 30 September 1953.

Evaluation of the report when submitted may indicate the desirability of further extension of the program initiated under this contract.

Yours very truly,

STEVENS INSTITUTE OF TECHNOLOGY
EXPERIMENTAL TOWING TANK

George R. Morris

George R. Morris

GRM:MR

27 JUL 1953

Encl (1)

22 JUL 1953

I TRIBUTION LIST - FINAL

30 April 1952

Date of Document

Nav-263(02)

ditional copies of all Research and Development Contracts 3 copies a4

ief, Reconciliation and Clearance Subdivision, Navy Audit Branch, neral Accounting Office, 1901 East 13th Street, Cleveland, Ohio 1 original

sistant Chief, Reconciliation and Clearance Subdivision, Navy Audit anch, General Accounting Office, 1901 East 13th Street, Cleveland, io (All Classified documents) 1 original

C, Washington, D. C. 1 original
n all Cost-plus fixed fee or cost without fee)
F (To GAO) (If required) 1 copy

sMat or BAR 3 copies

ntral Navy Regional Accounts Office, with DRC 1 copy
entioned in "Billing Instructions")
th Naval District
val Working Fund Letter (If required) 1 copy

reau of Supplies and Accounts, Code AP-2, Room 34, Arlington Annex 1 copy

reau of Supplies and Accounts, Code AP-111, lington Annex 1 copy

reau of Supplies and Accounts, Budget and Finance de OD-4, Room 1312, Arlington Annex (To be listed on DRC) 1 copy

rector, ONR Branch Office 5 copy

rector, ONR Branch Office (SanFran or Los Angeles) 5 copies

. Lynch, George Washington University, Room 13-15 aughton Hall, 707 22d Street, N. W., Washington 6, D. C. 2 copies

ntractor 6 copies

reau of Supplies and Accounts, Property Accounting vision (For Contracts having Government furnished material) 1 copy

ecial Devices Center, Sands Point, Port Washington, ng Island 6 copies

ecial Devices Liaison - Room T3-1815 - Miss Carr 1 cony

val Research Laboratory, Anacostia, Washington 20, C., Attn: Mr. T. M. Hemphill 6 copies

gnizant Section of ONR

rth Sciences	Physical Sciences	Mathematical Sciences
val Sciences	Biological Sciences	Biological Sciences
terial Sciences	Psychological Sciences	1 copy

iscal Sections - To be listed on DRO

NR (Decreases only) 1 copy
uShips 1 copy
uOrd (Designate cognizant NRAO on this copy) 1 copy
uAer 1 copy
uMed 1 copy
uPers 1 copy
uYds and Docks 1 copy
right-Patterson Air Force Base 1 copy

nsurance Branch, EXOS, Mr. Shetley, Room T3-1715 1 copy
On all Est. Cost Contracts)

ost Inspection Service, 1331 "U" Street, N. W. 5 copies
ashington, D. C. Attn: Mr. R. C. Kiser
On all Est. Cost contracts)

r. Pace, Room 1820 (All unclassified documents) 1 copy

roperty and Facilities, Code 264 1 copy

ode 263 (Overhead documents only) 1 copy

PECIAL REQUESTS

ll documents having BuMed Appropriations
inances Division, Naval Medical Center, Building 2
oom 214, Bethesda, Maryland 1 copy

uMed, Director, Research Division 1 copy

ll documents having BuShips Appropriations
uShips, Code 322, Attn: Mrs. Driscoll 1 copy

ommanding General, Air Materiel Command, Wright Patterson Air Force
ase, Dayton Ohio Attn: MCPPSS 30 copies
For documents having Air Force Appropriations)

ll documents relating to the contracts listed below
ffice of Fiscal Director
oom 4B683, Pentagon Building
ttn: Mr. Nichols 1 copy

5ori-60
OD 6964
5ori-78
6ori-102
6ori-110
6ori-126
6ori-131
6ori-201
6onr-231
6onr-244
6onr-241
6onr-271
7onr-291
N6onr-279
N7onr-321
N8onr-793
N8onr-648
Nonr-187(00)
Nonr-266(00)
Nonr-285(00)
Nonr-308(00)
Nonr-361(00)
Nonr-393(00)
Nonr-541(00)
Nonr-549(00)
Nonr-668(00)
Nonr-689(00)
Nonr-703(00)

ll documents having Hydrographic Appropriations
dyrographic Office ode 121, Room 218 1 copy
uitland, Maryland

EXPERIMENTAL TOWING TANK
STEVENS INSTITUTE OF TECHNOLOGY
711 HUDSON STREET HOBOKEN, NEW JERSEY
TELEPHONE HOBOKEN 3-8080

KENNETH S. M. DAVIDSON, DIRECTOR
ALLAN B. MURRAY, ASSISTANT DIRECTOR

HUGH W. MAC DONALD, EXECUTIVE DIRECTOR
GEORGE R. MORRIS, FINANCIAL OFFICER

12 December 1952

Office of Naval Research
Department of the Navy
Washington 25, D. C.

ATTENTION: Code 265

SUBJECT: Contract Nonr-26302
Amendment No. 4

Gentlemen:

We enclose herewith (2) executed copies of the subject amendment which extends the life of the contract through 31 July 1953 and reduces the maximum price to $24,496.00. Please provide us with (2) additional conformed copies for our files.

Very truly yours,

STEVENS INSTITUTE OF TECHNOLOGY
EXPERIMENTAL TOWING TANK

George R. Morris

GRM:ms
Encl.
cc: Supervisory Cost Inspector
Port Newark - Attn: Mr. Peduto

ONR - New York
Attn: Mr. Ferraras

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

RACT NUMBER: Nonr-263(02)
DMENT NUMBER: 4
ORITY: NR 341-009/9-23-52
OPRIATION: (See last paragraph hereof)
EASE: $15,004.00

ONR:262:THT:bs
Nonr-263(02)
(Mathematical Sciences Division)

Trustees of the
ens Institute of Technology
ken, New Jersey

Received
11/24

lemen:

s the desire of the Government and the Contractor that the instrumentation
e of the research and investigation of new approaches to the theory and design
utomatic controls of improved performances be deleted from Task Order Nonr-263(02)
to the difficulty in employing a subcontractor and that the contract be
inued with a more concentrated study on the mathematical phase as set forth in
ion A as now amended. To accomplish this, there are hereby provided a decrease
he estimated cost and an increase in the period of performance of said Task Order.

onsideration of the foregoing, said Task Order, as amended, is hereby further
ded as follows:

1. At the top of page 1, delete the Estimated Cost in its entirety and
titute in lieu thereof the following:

"ESTIMATED COST: $24,496.00."

2. On and after the date of this amendment, paragraph (3) of Section A shall
apply.

3. Delete Section C in its entirety and substitute in lieu thereof the
owing:

"SECTION C - The estimated cost of the performance of this Task Order is
ty four thousand four hundred and ninety six dollars ($24,496.00)."

4. Delete Section F in its entirety and substitute in lieu thereof the
owing:

"SECTION F - The performance of work under this Task Order shall commence
March 1951, and shall be completed on 31 July 1953."

amendment decreases the total estimated cost of Task Order Nonr-263(02) by
004.00, which decrease is credited to Appropriation 17X1317.10 Research Navy
enditure Account 46110) (Object Classification 079) Program Number 32000.

RACT NUMBER: Nonr-263(02)
DMENT NUMBER: 4

he foregoing is acceptable to you, please indicate your acceptance thereof by uting the enclosed two (2) copies of this letter, and return them to the Office aval Research, whereupon this letter and your acceptance thereof will constitute an amendment to the above numbered contract.

Sincerely yours,

Contracting Officer
Office of Naval Research
Department of the Navy

WITNESSES:

PTED THE TRUSTEES OF THE STEVENS INSTITUTE OF TECHNOLOGY
(Contractor)

(1)_____

(2)_____

NOTE: In the case of a corporation witnesses are not required but certificate below must be completed.

_____

E_____

CERTIFICATE

, certify that I am Secretary of the corporation named as Contractor in the going amendment; that , who signed said ıment on behalf of the Contractor was then aid corporation; that said amendment was duly signed for and in behalf of said oration by authority of its governing body and is within the scope of its orate powers.

_____
(Signature of person certifying)

(CORPORATE SEAL)

Mail Comment Sh
XOS 2116-C (3-51)

Route Sheet No.

61966

le	COMMENT
	File none - 263(02)
	According to Records this is for a "decrease" which went to ditto on 6 Nov 52. avd
5	Ready for signature

C O M M E N T   S H E E T

B51935

NR-3

61966

OFFICE OF NAVAL RESEARCH, NEW YORK
346 BROADWAY
NEW YORK 13, NEW YORK

ADDRESS REPLY TO
DIRECTOR
AND REFER TO:

L4-3/1N/SF:eb
Nonr-263(02)
Ser 8961
17 November 1952

From: Director, Office of Naval Research, New York
To: Chief of Naval Research (Code 262)

Subj: Contract Nonr-263(02), Stevens Institute of Technology, Hoboken, N. J.

Encl: (1) Stevens Inst ltr dtd 13 Nov 1952 to ONR Wash via ONR NY

1. The enclosure is forwarded for your information and action.

S. FERRARIS
By direction

EXPERIMENTAL TOWING TANK
STEVENS INSTITUTE OF TECHNOLOGY
711 HUDSON STREET HOBOKEN, NEW JERSEY
TELEPHONE HOBOKEN 3-8080

KENNETH S. M. DAVIDSON, DIRECTOR
ALLAN B. MURRAY, ASSISTANT DIRECTOR

HUGH W. MAC DONALD, EXECUTIVE DIRECTOR
GEORGE R. MORRIS, FINANCIAL OFFICER

13 November 1952

Department of the Navy
Office of Naval Research
Washington 25, D. C.

VIA: Office of Naval Research
346 Broadway
New York 13, New York

SUBJECT: Contract Nonr 26302

REFERENCE: (a) Stevens letter of 13 June 1952

(b) ONR letter of 1 October 1952
ONR:436:sl
NR 341 009
Ser 24766

Gentlemen:

By reference (a) request was made for an extension of the subject contract through 30 April 1953. Reference (b) indicated that the request under reference (a) had been referred to the contract division for action. Inquiry is made as to the present status of the request for extension of the subject contract.

Very truly yours,

STEVENS INSTITUTE OF TECHNOLOGY
EXPERIMENTAL TOWING TANK

George R. Morris

George R. Morris

GRM:ms

8885
4-3

10/23

	CONTRACT	TASK ORDER	AMENDMENT
...MBERS:	Nonr-263(00)	Nonr-263(02)	#4

...VERSITY
...NTRACTOR: The Trustees of the Stevens Institute of Technology

...E	Date and Initials	Comments
...-T	10/15/52 JHJ	
...J		
A / G	10/23/52 cwk	
K	wlg 10/23	
	Jum 10/30/52	
–		

K	Proofed: G.C.	Read by: B.S. 11-6-52
	Recorded: In wlg 11/4	Out wlg 11/6

...e ...ck		
	BW 10 NOV 1952	ND 11/24
	12/1 Bf	
	ND 12/1	mailed

11722 10/15/52

(Report of Obligation Decrease)

...following information should be forwarded to the Branch Office:
(1) Clearance Memorandum dtd. 15 October 1952
(2) Other (Indicate) No Cost Extension Amendment No. 4 to Task Order Nonr-263(02)

T. H. Thornton
(Signature)

T. H. Thornton

...0/52

nformation below applies only to the document which this accompanies)

ntractor The Trustees of the Stevens Institute of Technology Amount NONE

ntract No. Nonr-263(00) T. O. Nonr-263(02) Amend. #4 (No-cost)
decrease $15,004.00

r: (check one)

7 Research (Reports)

7 Development of training devices

7 Scientific Equipment

7 Other _____ (State)

Type of Contract (check one)

___(1) Fixed Price
___(2) Fixed Price, including price redetermination
___(2a) Fixed Price, with downward revision only
___(3) Fixed Price, including price escalation
___(4) Fixed Price, incentive
X (5) Cost
___(6) Cost Plus Fixed Fee
___(7) Time and Material
___(8) Other (specify) No-Cost

be dated not later than:

~~currently~~ 30 April 1952
if applicable, state reason below)

llar value being subcontracted None
llar volume being subcontracted to Small Business None

	YES
Statement from Contractor re use of a company or person to solicit	___
Have ☐ Have not ☐	
Planned Producer	___
Planned Item	___
Contracting Officer's Statement	___
Business Clearance (Navexos-2760)	___
Method of Contracting D & F (cost)	___
Is this contract susceptible to Small Business?	___
Contract with Small Business	___
Government Furnished Material	___
Renegotiation applicable to these funds 3rd 214	___
Naval Working Fund	___
Classified -	___
Subject to Vinson-Trammel Act	___
Subject to Walsh-Healey Act	___
Facilities Clearance	___

:hority under A. S. P. R. Not required on no-cost extension

authority other than A. S. P. R., state: _____

3/51

12/1

T. H. Thornton (Negotiator)

T. H. Thornton

CLEARANCE MEMORANDUM

NR 341-009/23 September 1952
Contract Number: Nonr-263(02)
Amendment Number: 4

Unclassified
15 October 1952

The Trustees of the
Stevens Institute of Technology
Hoboken, New Jersey

1. Negotiations

By letter dated 13 June 1952, Mr. George R. Morris, Financial Officer for the Stevens Institute of Technology, requested that a no-cost extension be negotiated for Task Order Nonr-263(02) and that the instrumentation aspect of this research be eliminated from said Task Order. It has been stated that the Contractor has had difficulty in reaching an agreement with the Arkania Regulator Company in regards to the subcontracting of this phase of the project and that it has been determined by ONR and the Stevens Institute of Technology that this part of the project be deleted.

Office of Naval Research New York, in their letter of 14 July 1952, indicated that a surplus of $28,785.00 was available at the end of the termination date of 1 May 1952. This surplus was due to the delay in work on the project and due to the difficulties in the subcontracting with the Arkania Regulator Company. The Scientific Officer has requested that $15,004.00 be deleted from the said Task Order, which was originally established for the purpose of conducting the instrumentation study. It has been stated that a surplus of $9,400.00 will be available after the deletion of the aforementioned study, and the Contractor is desirous of having a one year no-cost extension in order to continue the research from a mathematical standpoint. The Contractor proposed a one year extension from 1 May 1952 to 30 April 1953. It is to be noted, however, that the amendment contains an extension until 31 July 1953, in order to allow for the conduct of work to continue throughout the academic year of 1952 and 1953.

T. H. Thornton

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

'RACT NUMBER: Nonr-263(02) ONR:262:THT:
IDMENT NUMBER: 4 Nonr-263(02)
IORITY: NR 341-009/9-23-52 (Mathematical Sciences
:OPRIATION: (See last paragraph hereof) Division)
:EASE: $15,004.00

Trustees of the
'ens Institute of Technology
)ken, New Jersey

:lemen:

.s the desire of the Government and the Contractor that the
;rumentation phase of the research and investigation of new
'oaches to the theory and design of automatic controls of
'oved performances be deleted from Task Order Nonr-263(02)
to the difficulty in employing a sub-contractor and that the
;ract be continued with a more concentrated study on the
iematical phase as set forth in Section A as now amended. To
)mplish this there are hereby provided a decrease in the estimated
; and an increase in the period of performance of said Task Order.

:onsideration of the foregoing, said Task Order, as amended, is
)by further amended as follows:

1. At the top of page 1, delete the Estimated Cost in its
.rety and substitute in lieu thereof the following:

"ESTIMATED COST: $24,496.00."

2. On and after the date of this amendment, paragraph (3) of
:ion A shall not apply.

3. Delete Section C in its entirety and substitute in lieu
:eof the following:

"SECTION C - The estimated cost of the performance of this
: Order is twenty four thousand four hundred and ninety six dollars
4,496.00)."

4. Delete Section F in its entirety and substitute in lieu
:eof the following:

"SECTION F - The performance of work under this Task Order
11 commence on 1 March 1951, and shall be completed on 31 July 1953."

MENT JUSTIFICATION — OFFICE OF NAVAL RESEARCH — RESTRICTED

3234 (7-51)

SECTION I - BASIC DATA

ECTING AGENCY - BRANCH AND CODE

hematics Branch, Code 432

5. CONTRACT NO.

Nonr-26303

TLE OF TASK

Study of Automatically
rammed Control Systems

7 ADDRESS OF CONTRACTOR TO PERFORM WORK

rens Institute of Technology
oken, New Jersey

Basic

AL INVESTIGATOR(S)

M Davidson

OF PARTICIPATING SCIENTISTS

GRADUATE STUDENTS 1

K SUPERVISOR (Name and code)

A. Grad, Code 432

PERATING BRANCHES (Financial support only)

2. SECURITY CLASSIFICATION OF TASK

Unclassified

3. DATE

23 Sept. 1952

7. (A) PROJECT NO. NR

341 000

(B) OPERATIONAL REQUIREMENTS NO.

SR 10701

(C) PROJECT TITLE (If task contributes to two or more projects, list projects and explain, if necessary)

Research on the use of digital computer techniques in military control systems.

8. THIS TASK ALSO SUPPORTS OPERATIONAL REQUIREMENTS

14. INDICATE WHICH OF FOLLOWING APPLIES TO THIS TASK

- [ ] NEW
- [ ] ACCELERATION
- [ ] RENEWAL
- [X] NO FUNDS EXTENSION
- [ ] OVER-RUN

15. ESTIMATED COMPLETION DATE OF TASK

31 July 1953

16. ESTIMATED DURATION (This commitment of funds)

FROM 1 May 1952 TO 31 July 1953

RCE OF FUNDS FOR THIS COMMITMENT

	AMOUNT OF COMMITMENT	FY
	None	
NCIES		

nds are transferred FROM another source
ill out Supplement A (NAVEXOS-3235).
nds are to be transferred to another
agency to make this contract, name
out Supplement B (NAVEXOS-3235).

18. FOR FISCAL DIVISION USE ONLY

APPROPRIATION	AUTHORIZATION NO.	PROGRAM OR CONTROL NO.	EXPENDITURE ACCOUNT	OBJECT CLASS

FUNDS COMMITTED

AMOUNT	
DATE	
BY	

ACCOUNTING CLASSIFICATION

- [ ] FORMAL OBLIGATION
- [ ] INFORMAL OBLIGATION

COMMITMENTS OF FUNDS ALREADY MADE AND/OR PLANNED

	FY	ONR	ALL OTHERS
CURRENT	1951	$ 39,500.00	$
FUTURE			
FUTURE			

	FY	ONR	ALL OTHERS
CURRENT		$	$
FUTURE			
FUTURE			

SECTION II - APPROVAL

D, BY

A. Grad, Acting (Head)

BRANCH: Mathematics — DATE

DIVISION: Mathematical Sciences Division — DATE

Mina Rees (Director)

COMMITTEE — DATE

ASSISTANT CHIEF FOR RESEARCH — DATE

(Over)

RESTRICTED

REMENT JUSTIFICATION

2770 (9-48)

OFFICE OF NAVAL RESEARCH

RESEARCH GROUP OPERATIONAL REQUIREMENT AD 09401

(Submit original and four copies)

lect NR 341 009

xxxxxxSubtask

SECURITY CLASSIFICATION	TYPE PROJECT	
UNCLASSIFIED	X NEW	RE-NEWAL (Other)

DESIGNATION NO.	CONTRACT NO.	TASK ORDER	DATE
1 009			19 Jan 1951

NTIFIC OFFICER

F. Joachim Weyl

re)

OR AND ADDRESS

ens Institute of Technology
ken, New Jersey

L INVESTIGATOR

eth S. M. Davidson

TITLE

y of Automatically Programmed
rol Systems

Do not write in this space

P.O. NO.	PROGRAM NO.

APPROPRIATION(S)

OBJECT CLASS	EXPENDITURE ACCOUNT NO.

ESTIMATED MAN YEARS

PROF. 1 GRAD. STUD. 2

ESTIMATED COMPLETION DATE TOTAL PROJECT

1 March 1953

I ANY GOVERNMENT AGENCY DO
RK IN THE TIME SPECIFIED? ☐ YES ☒ NO

REPORTS REQUIRED
(Quarterly, monthly, etc.)

FISCAL ESTIMATES	THIS COMMITMENT (EST.)
PAST 1947 $	BASIC $
PAST 1948 $	APPLIED 39,500:00
FUTURE 1950 $	COST SHARING FUNDS 39,500:00
FUTURE 1951 $	OTHER $

TUS

ENTIFIC
/OR TECHNICAL as justified

ERS: AS
UESTED OR-

AL

DURATION

FROM 1 March 1951 TO 31 December 1951

THIS CONTRACTOR SELECTED?

nnel at the Experimental Towing Tank, Stevens Institute of Technology,
in the past carried on successfuly studies concerning the influence
ability and maneuverability on control system design. These
es have suggested the research to be conducted under this task for
the Stevens Institute group is therefore particularly qualified.

TED AGENCIES CORRESPONDENCE NOT ATTACHED, ETC.:

BuShips
NADC, Johnsville, Pa.

Enclose
341-009

):

(3)
SCIENCE DIRECTOR, RESEARCH

(Branch) Mathematics

(4)
ASST. CHIEF FOR RESEARCH

TOR (Division) Mathematical Sciences

(5)
DEPUTY AND ASSISTANT CHIEF OF NAVAL RESEARCH

RES: (a) Original copy of proposal & contractor's business office approval
(b) Justification and Brief (Use reverse side)

8-5112

41 009

e: (1) Scientific Justification (2) Brief of Project (3) Possible Naval Application

The investigations to be carried out under this task are concerned automatic control systems for the execution of major maneuvers. distinguishes them clearly from systems designed for the purpose of se-keeping where it is merely a matter of correcting for the com- tively minor random disturbances caused by an inhomogeneous or noisy ronment. The performance of the type of control system to be in- igated must be evaluated from such viewpoints as the execution of a red maneuver in least time or with least effort, etc. This is in rast to course-keeping type of controls whose aim is generally the mization of mean square errors. The proposed viewpoint appears to new one in the field of control system development and certainly ants careful investigation. The Stevens Institute of Technology l be supported in this study by engineers from the Askania Regula- Company and by the Mathematics Department at Princeton University lying respectively practical advice and the assurance of theoretical dness.

Two particular types of automatically programmed control systems are e studied as to their feasibility. The first one is centered on an ogue computing device which from known instantaneous conditions and ssumed future program predicts rapidly the remainder of the maneuver. he prediction differs from the desired outcome a systematic correction he control program is made and the computation repeated with the initial conditions. In this fashion those parts of the control ram lying in the immediate future will be defined with greater and ter precision, and will be executed as real time catches up with . The second type of system envisages the preliminary computation ptimum control sequences for a sufficiently large family of repre- ed maneuvers. The relation which is thus established between the red maneuver and required control command sequence is then to be ied from the viewpoint of realizing it in a compact analogue device e function might be described as that of looking in a table of pos- e command sequences for the one corresponding to the maneuver to be uted. Since in particular the requirement of maneuvers in minimum of will generally require that the controls are used to saturation of current study will work essentially with black-white controls.

The possible naval applications are found in any situation where r maneuvers have to be executed with such accuracy in timing as to out the use of human operators or under conditions where no human ators are on hand. Example of this can be found in the maneuver igh speed aircraft from tally-ho to the point of firing a guided ile at a target; in the maneuver of a guided missile from the ant of release to the instant when homing devices take over the ance control; in the rapid execution of evasive maneuvers by high d aircraft and in depth changes on the part of high speed submarines.

Operational Requirement: AD 09401.

INTER-DEPARTMENT COMMUNICATION

EXPERIMENTAL TOWING TANK

TO: Dr. Di Prima ✓ DATE: 5 August 1952

CC: G. R. Morris
B. H. Peters

SUBJECT: Project EA 1403
Estimate for 12 Month Period
1 August 1952 to 1 August 1953

FROM: H. W. MacDonald REFERENCE: NONR 263 T.O. 2

Balance 31 July 1952 = $ 24,404.88

Publication Bushaw Report	- $ 900.00	
Salaries - Rose	2240.00*	
Salaries - Supervision	2100.00	
Computing	2580.00	
Publication - Rose report	1500.00	
	$ 9320.00	
	Say $ 9400.00	

Contract Overhead

*Based on 1-day/week for 10 months and 5-days/week for 2 months.

Balance in T.O. 2 on 1 August	$ 24,404.88
Estimated requirements T.O. 2 for 12 months.	9,400.00
Balance	$ 15,004.88

HWM:ms

Richmond

Less overseas transport

R-3

OFFICE OF NAVAL RESEARCH, NEW YORK

346 BROADWAY
NEW YORK 13, NEW YORK

ADDRESS REPLY TO COMMANDING OFFICER AND REFER TO:

L4-3/1N/SF:cm
Nonr-26302
Serial 5687

14 July 1952

From: Director, Office of Naval Research, New York
To: Chief of Naval Research (Code 432)
Via: Code 430

Subj: Contract Nonr-26302, Stevens Institute of Technology, NR 341-009; Branch Office Individual Contract Fiscal Status Report

Encl: (1) Copy of Stevens Institute of Technology ltr of 25 June 1952 to ONR NY with 2 copies enclosure thereto

1. Enclosure (1) is forwarded herewith for information and as a supplement to the Stevens Institute of Technology recent request for a no cost extension of subject task order to 30 April 1953.

2. Basic background information in connection with subject contract is as follows:

a. The present expiration date is 30 April 1952.

b. The contract began on 1 March 1951 and a total of $39,500 has been allocated to date.

c. The contract allocated $39,500 for the twelve month period beginning 1 March 1951 and ending 29 February 1952. Amendment No. 3 dated 29 February 1952 extended the contract performance period to 30 April 1952 without increase in funds.

3. Current Fiscal Information:

a. Current period began 1 March 1951 and ended 30 April 1952.

b. Expenditures for Current Period:

(1) Type	(2) Budget	(3) Expended/Obligated thru 30 Apr 1952	(4) Balance as of 1 May 1952
Wages and Salaries	10,080	3,443	6,637
Overhead	12,620	4,460	8,160
Material/Supplies	1,000	2,560	(1,560)
Travel	800	252	548
Subcontract with Arkania Regulator Co.	15,000	-	15,000
	39,500	10,715	28,785

23 JUL 1952

47625

L4-3/lN/SF:cm
Nonr-26302
Serial 5687
14 July 1952

c. Current period has been completed.

d. Surplus at end of current period is $28,785.

e. The reasons for the surplus at the end of the current period are that the subcontract with Arkania Regulator Co. was never executed and the Institute did not expend the anticipated man hours of labor during this period. The latter has been due to the fact that the Office of Naval Research, Washington and Stevens Institute of Technology have not been in agreement concerning direction of effort on this problem. It has recently been decided that the work is to proceed as a mathematical study without any attempt at instrumentation at this time. The contractor's budget for the period beginning 1 May 1952 and ending 30 April 1953 indicates how it intends to use this surplus.

4. Discussion of Proposal:

Dr. R. R. Williamson was the responsible investigator under the task order. He submitted his resignation from the staff of Stevens Institute of Technology effective 1 July 1952. The Institute has informally advised that some of his work will be taken over by Assistant Dean N. J. Rose. It is the understanding of this office that the professional accomplishments and backgound of Dean Rose is familiar to the Scientific personnel at Office of Naval Research, Washington. For cost purposes, the Institute proposes to treat Dean Rose as a consultant and would bill the contract at the rate of $28 per day. In addition, the Institute would continue to utilize the services of Donald W. Bushow as a Mathematician, at the rate of $23 per day. The Stevens Institute of Technology has advised that the budget is at the moment considered a very flexible one and subject to many changes. A meeting is being arranged between Office of Naval Research, Washington and contractor personnel to discuss the budget, change of personnel and other matters. The contractor requested that it be allowed to withhold further comment on the details of construction of the budget until after the scheduled meeting with Office of Naval Research, Washington representatives.

Bob O. Mathews

BOB O. MATHEWS

23 JUL 1952

EXPERIMENTAL TOWING TANK
STEVENS INSTITUTE OF TECHNOLOGY
HOBOKEN, NEW JERSEY

25 June 1952

Office of Naval Research
Department of the Navy
346 Broadway
New York 13, New York

Attention: Mr. S. Ferraris

Subject: Contract Nonr-263(02)

Reference: ONR letter 20 June 1952
L4-3/1N/SF:jc Serial 5110

Gentlemen:

We enclose herewith revised budget covering performance under the subject contract for the period 1 May 1952 through 30 April 1953, as requested by our copy of the reference letter.

Yours very truly,

EXPERIMENTAL TOWING TANK

George R. Morris
Financial Officer

GRM:MR
Enclosure

Encl (1)

Experimental Towing Tank
Stevens Institute of Technology
Hoboken, New Jersey

ESTIMATED BUDGET 1 MAY 1952 - 30 APRIL 1953

Contract Nonr-26302

	Hours	Rate*	Salary
Engineers and Scientists	2313	3.22	7447.86
Chief Technical Assistants	710	2.10	1491.00
Miscellaneous Laboratory Assistants	775	1.28	992.00
			9930.86
Overhead at 133% through 30 September 1952 and estimated at that rate thereafter			13208.04
Consultation ($450. month)			5400.00
Travel, miscellaneous materials, etc.			250.00
			28788.90

*Averaged rates for purposes of this tabulation only.

Approximate average monthly rate of expenditures:

Salary	827.57
Overhead	1100.67
Consultation	450.00
Materials, Travel	20.83
	2399.07

(Balance in Contract 30 April 1952 $28784.54)

IR-3

45308

260
268

OFFICE OF NAVAL RESEARCH, NEW YORK

346 BROADWAY

NEW YORK 13, NEW YORK

ADDRESS REPLY TO COMMANDING OFFICER AND REFER TO:

L4-3/1N/SF:jc
Nonr-263-2
Ser 5110

20 June 1952

From: Director
To: Chief of Naval Research (Code 268)

Subj: Contract Nonr-26302, Stevens Institute of Technology, Hoboken, NJ

Encl: (1) Orig & 2 cys SIT ltr /s/ Morris dtd 13 June 1952 to CNR

1. Enclosure (1) is forwarded for appropriate action.

2. The contractor has advised this office that during a recent conference between Stevens Institute personnel and Dr. C. R. De Prima, Code 432, Office of Naval Research, Washington, it was decided to continue the work as a mathematical study. The subcontract with the Askania Regulator Company, which was approved by ONR, Washington, was not executed.

3. It is recommended that the contractor's request for no cost extension to 30 April 1953 be approved and amendment issued at the earliest practicable date. The present expiration date is 30 April 1952.

4. By copy of this letter, Stevens Institute of Technology is requested to furnish this office a revised budget covering the period 1 May 1952 to 30 April 1953.

S. FERRARIS
By direction

Copy to
Mr. George R. Morris, SIT

1- JUL 1952

341-009

EXPERIMENTAL TOWING TANK
STEVENS INSTITUTE OF TECHNOLOGY
711 HUDSON STREET HOBOKEN, NEW JERSEY
TELEPHONE HOBOKEN 3-8080

KENNETH S. M. DAVIDSON, DIRECTOR
ALLAN B. MURRAY, ASSISTANT DIRECTOR

HUGH W. MAC DONALD, EXECUTIVE DIRECTOR
GEORGE R. MORRIS, FINANCIAL OFFICER

13 June 1952

Department of the Navy
Office of Naval Research
Washington 25, D. C.

VIA: Department of the Navy
Office of Naval Research
346 Broadway
New York 13, New York

SUBJECT: Contract Nonr-263(02)

Gentlemen:

Reference is made to the recent decision changing the direction of the research under the subject contract. As the work is now to proceed as a mathematical study, without any attempt at instrumentation at this time, it is requested that the time of performance be extended through 30 April 1953.

Yours very truly,

STEVENS INSTITUTE OF TECHNOLOGY
Experimental Towing Tank

George R. Morris
Financial Officer

GRM:jsd

341-009

I TRIBUTION LIST - FINAL

Nonr-263(02)23

Date of Document 29 Feb. 1952

ditional copies of all Research and Development Contracts	3 copies
ief, Reconciliation and Clearance Subdivision, Navy Audit Branch, neral Accounting Office, 1901 East 13th Street, Cleveland, Ohio	1 original
sistant Chief, Reconciliation and Clearance Subdivision, Navy Audit anch, General Accounting Office, 1901 East 13th Street, Cleveland, io (All Classified documents)	1 original
, Washington, D. C.	1 original
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val Sciences	Biological Sciences	Biological Sciences
terial Sciences	Psychological Sciences	1 copy

scal Sections - To be listed on DRC

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. Pace, Room 1820 (All unclassified documents)	1 copy
operty and Facilities, Code 264	1 copy
de 263 (Overhead documents only)	1 copy

ECIAL REQUESTS

l documents having BuMed Appropriations nances Division, Naval Medical Center, Building 2 om 214, Bethesda, Maryland	1 copy
Med, Director, Research Division	1 copy
l documents having BuShips Appropriations Ships, Code 322, Attn: Mrs. Driscoll	1 copy
mmanding General, Air Materiel Command, Wright Patterson Air Force se, Dayton Ohio Attn: MCPPSS or documents having Air Force Apropriations)	30 copies

l documents relating to the contracts listed below

ffice of Fiscal Director om 4B683, Pentagon Building tn: Mr. Nichols	1 copy

ori-60	N6onr-279	Nonr-668(00)
D 6964	N7onr-321	Nonr-689(00)
ori-78	N8onr-793	Nonr-703(00)
ori-102	N8onr-648	
ori-110	Nonr-187(00)	
ori-126	Nonr-266(00)	
ori-131	Nonr-285(00)	
ori-201	Nonr-308(00)	
onr-231	Nonr-361(00)	
onr-244	Nonr-393(00)	
onr-241	Nonr-541(00)	
onr-271	Nonr-549(00)	
onr-291		

l documents having Hydrographic Appropriations dyrographic Office Code 121, Room 218 uitland, Maryland	1 copy

EXPERIMENTAL TOWING TANK

STEVENS INSTITUTE OF TECHNOLOGY

711 HUDSON STREET HOBOKEN, NEW JERSEY

TELEPHONE HOBOKEN 3-8080

KENNETH S. M. DAVIDSON, DIRECTOR
ALLAN B. MURRAY, ASSISTANT DIRECTOR

HUGH W. MAC DONALD, EXECUTIVE DIRECTOR
GEORGE R. MORRIS, FINANCIAL OFFICER

13 June 1952

Department of the Navy
Office of Naval Research
Washington 25, D. C.

SUBJECT: Contract Nonr-263(02)
Amendment No. 3

REFERENCE: ONR:265:FKD
Nonr-263(02)

Gentlemen:

We are resubmitting herewith two executed copies of the subject amendment with our corporate seal affixed. It is requested that we be provided with two conformed copies for our files.

STEVENS INSTITUTE OF TECHNOLOGY
Experimental Towing Tank

GEORGE R. MORRIS
Financial Officer

GRM:jsd
Enc.

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

CONTRACT NUMBER: Nonr-263(02)
AMENDMENT NUMBER: 3

ONR:262:THT:rch
Nonr-263(02)
(Mathematical Sciences Division)

The Trustees of the
Stevens Institute of Technology
Hoboken, New Jersey

Gentlemen:

To provide the Contractor sufficient time within which to prepare and submit the final report and fulfill all other necessary requirements of the research under Task Order Nonr-263(02), it has been determined to extend the period of performance of said Task Order.

In consideration of the foregoing, said Task Order, as amended, is hereby further amended by deleting Section F in its entirety and substituting in lieu thereof the following:

"SECTION F - The performance of work under this Task Order shall commence on 1 March 1951, and shall be completed on 30 April 1952."

This amendment makes no change in the estimated cost of Task Order Nonr-263(02).

Recd copy
2 to NY
5/27

(EXOS 2185-17-2 (Rev. 3-51)

NTRACT NO. Nonr- 263(02)

ENDMENT NO. 3

he foregoing is acceptable to you, please indicate your acceptance thereof by executing the enclosed two copies of this letter, and return them to the Office of Naval Research, whereupon this letter and your acceptance thereof will constitute this an amendment to the above numbered Task Order.

Sincerely yours,

Contracting Officer
Office of Naval Research
Department of the Navy

THE TRUSTEES OF THE STEVENS
CEPTED INSTITUTE OF TECHNOLOGY
(Contractor)

WITNESSES:

(1)_____

(2)_____

_____

.E_____

NOTE: In the case of a corporation witnesses are not required but certificate below must be completed.

CERTIFICATE

, certify that I am
Secretary of the corporation named as Contractor in the foregoing amend-
t; that , who signed said amendment on behalf of the Con-
tor was then of said corporation: that said amendment
duly signed for and in behalf of said corporation by authority of its governing body and is within the scope
s corporate powers.

_____
(Signature of person certifying)

(CORPORATE SEAL)

ONR:265:FKD
Nonr-263(02)

The Trustees of the
Stevens Institute of Technology
Hoboken, New Jersey

Subject: Research Contract Nonr-263(02), Amendment 3.

Gentlemen:

The two copies of the subject amendment are returned herewith for completion of the execution pages by affixing your Corporate Seal to each copy.

Sincerely yours,

J. A. [illegible]
Head, Contract Distribution Branch
By direction of
Chief of Naval Research

Encl:
Two copies of the subject
amendment

EXPERIMENTAL TOWING TANK
STEVENS INSTITUTE OF TECHNOLOGY
711 HUDSON STREET HOBOKEN, NEW JERSEY
TELEPHONE HOBOKEN 3-8080

KENNETH S. M. DAVIDSON, DIRECTOR
ALLAN B. MURRAY, ASSISTANT DIRECTOR

HUGH W. MAC DONALD, EXECUTIVE DIRECTOR
GEORGE R. MORRIS, FINANCIAL OFFICER

3 June 1952

Department of the Navy
Office of Naval Research
Washington 25, D. C.

ATTENTION: Code 265

SUBJECT: Amendment No. 3 to
Contract Nonr-263(02)

Gentlemen:

We return herewith two executed copies of the subject amendment which extends the period of performance through 30 April 1952.

It is requested that we be provided with two conformed copies for our records.

Yours very truly,

STEVENS INSTITUTE OF TECHNOLOGY
Experimental Towing Tank

George R. Morris

GRM:jsd
Enc.

41546

1-1006 (REV. 1/49)

USE FOR URGENT LETTERS ONLY

NAVAL SPEEDLETTER

DO NOT CLEAR THROUGH COMMUNICATION OFFICE

must be checked)

AR MAIL ☐ SPECIAL DELIVERY

AIL ☐ REGISTERED MAIL

CLASSIFICATION

Unclassified

IN REPLY REFER TO

L4-3/1N/SF:cm
Nonr-263(02)
Serial 8991

DATE

20 May 1952

FROM:

TO: Director
Chief of Naval Research (Code 262)
Washington 25, D. C.

NAVAL SPEEDLETTER—

Permits dispatch or informal language.

May be sent (1) with enclosures, (2) in a window envelope (size 8⅞" x 3⅞"), if contents are not classified as confidential or higher, (3) to both naval and nonnaval activites.

Is packaged 500 sheets of white or of one color: yellow, pink, or green.

e Contract Nonr-263, Task Order 2 with Stevens Institute of Tech. present xpiration date of task order is 29 February 1952. Contractor requested o cost extension on 11 December 1951. Code 432 letter, Serial 10453 dated 1 April indicated extension approved by Math. Branch and forwarded to ontract Division for negotiation. Contractor has submitted invoices for arch and April costs. In view of ONR, Wash. directive to process maximum mount of outstanding claims prior to 30 June 1952, request you advise status f amendment.

S. FERRARIS
By direction

NR Wash (Code 432)

ESS:

Office of Naval Research, New York
346 Broadway
New York 13, N. Y.

← SENDER'S MAILING ADDRESS

Address reply as shown at left; or reply hereon and return in window envelope (size 8⅞" x 3⅞"), if not classified as confidential or higher.

CLASSIFICATION Unclassified

3ND P&PO-(50)

CON CTNonr-263(00) TASK ORDER Nonr-2 02 AMENDMENT 3

JMBERS: Nonr-263(02) 3 5/14

ONTRACTOR: Stevens Institute of Technology

CODE	DATE AND INITIALS	COMMENTS
262-T	5/2/52 J.X.S	
262K	5/3/52 mcD	
262J	5/7/52 JOB	
262	5/14 DMK	
106	[illegible] 5/16/52	
262-		
262K	Proofed: MS Read by: MD Recorded: In 5/16/52 mcP Out 5/26/52 MD	
(Page 262J Check)	[illegible] 5/23/52	
260A		
265	BW MAY 26 1952 5/27	
260	5/28 [illegible]	
265	MD 5/28 mailed	

(Report of Obligation 5/ Cost)

The following information should be forwarded to the Branch Office:

(1) Clearance Memorandum _____

(2) Other (Indicate) _____

5/29/52

D. X. Stanton
(SIGNATURE)

9/21/49

'mation below applies only to the document which this accompanies)

ıctor Stevens Institute of Technology Amount None

ıct No. Nonr-263(00) T.O. Nonr-26302 Amend. 3

check one)

Research, (Reports)

Development of training devices

Scientific Equipment

Other _____ (state)

dated not later than:

9 February ~~30 April~~ 1952

f applicable, state reason below)

Type of Contract (check one)

___ (1) Fixed Price
___ (2) Fixed Price, including price redetermination
___ (2a) Fixed Price, with downward revision only
___ (3) Fixed Price, including price escalation
___ (4) Fixed Price, incentive
___ (5) Cost
___ (6) Cost Plus Fixed Fee
___ (7) Time and Material
___ (8) Other (specify) N/C

value being subcontracted.

volume being subcontracted to Small Business.

	YES
Statement from Contractor re use of a company or person to solicit	___
Have ☐ Have not ☐	
Planned Producer	___
Planned Item	___
Contracting Officer's Statement	___
Business Clearance (Navexos-2760)	___
Method of Contracting D & F (cost)	___
Is this contract susceptible to Small Business?	___
Contract with Small Business	___
Government Furnished Material	___
Renegotiation applicable to these funds	___
Naval Working Fund	___
Classified	___
Subject to Vinson-Trammel Act	___
Subject to Walsh-Healey Act	___
Facilities Clearance	___

3rd NN

ity under A. S. P. R. Not required; no cost extension to 4/30/52

hority other than A. S. P. R., state _____

5/28

D. H. Stanton
(Negotiator)

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

CONTRACT NUMBER: Nonr-263(02)
AMENDMENT NUMBER: 3

ONR:262(X):THT:
Nonr-263(02)
(Mathematical Sciences
Division)

The Trustees of the
Stevens Institute of Technology
Hoboken, New Jersey

Gentlemen:

To provide the Contractor sufficient time within which to prepare and submit the final report and fulfill all other necessary requirements of the research under Task Order Nonr-263(02), it has been determined to extend the period of performance of said Task Order.

In consideration of the foregoing, said Task Order, as amended, is hereby further amended by deleting Section F in its entirety and substituting in lieu thereof the following:

"SECTION F - The performance of work under this Task Order shall commence on 1 March 1951, and shall be completed on 30 April 1952."

This amendment makes no change in the estimated cost of Task Order Nonr-263(02).

L. K. Thornton
Negotiator

2 May 1952
Date

ENT JUSTIFICATION
234 (7-51)

OFFICE OF NAVAL RESEARCH

Part 2

RESTRICTED

SECTION I - BASIC DATA

32

ECTING AGENCY - BRANCH AND CODE
ematics Branch - Code 432

2. SECURITY CLASSIFICATION OF TASK
Unclassified

3. DATE
3 April 1952

. NR
009

5. CONTRACT NO.
Nonr-26302 (03)

7. (A) PROJECT NO. NR
341-000

(B) OPERATIONAL REQUIREMENTS NO.
AD-09401

ITLE OF TASK
Study of Automatically
rammed Control Systems

(C) PROJECT TITLE *(If task contributes to two or more projects, list projects and explain, if necessary)*
Mathematical Studies
of Guidance and Control Systems

D ADDRESS OF CONTRACTOR TO PERFORM WORK
ens Institute of Technology
ken, N.J.

8. THIS TASK ALSO SUPPORTS OPERATIONAL REQUIREMENTS

PAL INVESTIGATOR(S)
R. Williamson

14. INDICATE WHICH OF FOLLOWING APPLIES TO THIS TASK
☐ NEW ☐ ACCELERATION
☐ RENEWAL ☒ NO FUNDS EXTENSION ☐ OVER-RUN

OF PARTICIPATING SCIENTISTS
1 GRADUATE STUDENTS 2

15. ESTIMATED COMPLETION DATE OF TASK

SK SUPERVISOR *(Name and code)*
Charles R. DePrima

OPERATING BRANCHES *(Financial support only)*

16. ESTIMATED DURATION *(This commitment of funds)*
FROM 1 March 1952 TO 30 April 1952

IRCE OF FUNDS FOR THIS COMMITMENT

	AMOUNT OF COMMITMENT	FY
ENCIES		

unds are transferred FROM another source
fill out Supplement A (NAVEXOS-3235).
unds are to be transferred to another
r agency to make this contract, name
out Supplement B (NAVEXOS-3235).

19. FOR FISCAL DIVISION USE ONLY

APPROPRIATION	AUTHORIZATION NO.	PROGRAM OR CONTROL NO.	EXPENDITURE ACCOUNT	OBJECT CLASS

FUNDS COMMITTED	
AMOUNT	
DATE	
BY	

ACCOUNTING CLASSIFICATION
☐ FORMAL OBLIGATION
☐ INFORMAL OBLIGATION

COMMITMENTS OF FUNDS ALREADY MADE AND/OR PLANNED

	FY	ONR	ALL OTHERS
	1951	$ 39,500	$

	FY	ONR	ALL OTHERS
CURRENT		$	$
FUTURE			
FUTURE			

SECTION II - APPROVAL

VED BY
CHAS. R. DePRIMA *(Head)*

BRANCH
Mathematics

DATE

MINA REES *(Director)*

DIVISION
Mathematical Sciences

DATE

E COMMITTEE

DATE

ASSISTANT CHIEF FOR RESEARCH

DATE

(Over)

RESTRICTED

ONR-3

OFFICE OF NAVAL RESEARCH, NEW YORK
346 BROADWAY
NEW YORK 13, NEW YORK

ADDRESS REPLY TO COMMANDING OFFICER AND REFER TO:

L4-3/LN/CHE:sw
Nonr-26302
Serial No. 211

7 January 1952

From: Commanding Officer
To: Chief of Naval Research
Attn: Code 432
Via: Code 402

Subj: Contract Nonr-26302, Stevens Institute of Technology, NR 341-009; Branch Office individual contract fiscal status report

Encl: (1) Orig and 1 cy of renewal proposal
(2) ONR NY ltr ser 210 of 7 Jan 1952 to Code 268

1. Basic background information in connection with subject contract is as follows:

a. Present expiration date is 29 February 1952.

(1) Comments: Expiring appropriation number is 17X1317.10, Research Navy. Total amount of funds allocated to 29 February 1952 is $39,500.

2. Current fiscal information:

a. Current period beginning on 1 March 1951 and ending on 29 February 1952.

b. Expenditures for current period:

Type	Budget	Expended/Obligated	Balance As of 9/30/51
Wages/Salaries	10,080	500.	9,580
Overhead	12,620	625.	11,995
Materials/Supplies	1,000	775.	225
Travel	800	304.	496
Askania Reg. Co.	15,000		15,000
Totals	39,500	2,204	37,296

c. Estimated to complete through current period $3,000.

d. Apparent surplus expected at present ending date $34,296.

e. Estimated net surplus expected at present ending date $34,296.

11 JAN 1952

L4-3/LN/CHE:sw
Nonr-26302
Serial No. 211

7 January 1952

f. Explanation in connection with any net surplus expected:

This contract has been delayed for an extended period of time due to the fact that the subcontract with Askania Regulator Company of Chicago has not been progressing due to disagreement in subcontract requirements. This problem was referred to this office on 3 December and steps have been taken to facilitate the subcontract. Enclosure (2) was a letter to Code 268 in this regard.

In view of this delay, Stevens has requested an extension of subject contract, by enclosure (1), through 31 December 1952. The Office of Naval Research, New York, concurs with the necessity for this extension.

E. O. HEBERER
Acting

None: 263(02), a2

DISTRIBUTION LIST -

Date of Document 1 May 1952

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Mr. Lynch, George Washington University 2 copies
Rooms 13-15 Staughton Hall,
707 22d Street, N. W., Washington 6, D. C.

Contractor 6 copies

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Division (For contracts having Government furnished material)

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Mr. Pace, Room 1820 (All unclassified documents)	1 copy
Property and Facilities, Code 264	1 copy

Cognizant Section of ONR

Natural Sciences	Earth Sciences	Biological Sciences
Physical Sciences	Naval Sciences	Mathematical Sciences
Material Sciences	Human Resources	1 copy

Special Requests

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Finances Division, Naval Medical Center, Building 2
Room 214, Bethesda, Maryland — 1 copy

BuMed, Director, Research Division — 1 copy

All documents having BuShips Appropriations
BuShips, Code 322, Attn: Mrs. Driscoll — 1 copy

All documents relating to the contracts listed below
Office of Fiscal Director
Room 4B683, Pentagon Building
Attn: Mr. Nichols — 1 copy

MIT - N5ori-60 and Task I thereunder
NOD 6964 and Task Order I thereunder
N5ori-78 and all Task Orders thereunder
N6ori-126
N6ori-241
N6ori-110
N6onr-271
N6ori-131
N6ori-102
N6onr-244
N6onr-231
N8onr-793
N7onr-321
N7onr-291 and all Task Orders
N8onr-648
Nonr-187(00)
Nonr-285(00)
N6onr-279
N6ori-201
Nonr-308(00)
Nonr-541(00)
Nonr-361(00)
Nonr-689(00)
Nonr-703(00)
Nonr-393(00)
Nonr-549(00)

All documents having Hydrographic Appropriations
Hydrographic Office, Code 121, Room 218
Suitland, Maryland — 1 copy

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

CONTRACT NUMBER: Nonr-263(02)
AMENDMENT NUMBER: 2

ONR:263:BAT:bs
Nonr-263(02)
(Mathematical Sciences Division)

The Trustees of the Stevens
Institute of Technology
Hoboken, New Jersey

Gentlemen:

To establish the overhead rate applicable under Task Order Nonr-263(02) for the period from 1 October 1951 to 30 September 1952, in accordance with the provisions of Section 24(a)(7) of the contract, said Task Order, as amended, is hereby further amended by adding the following under the tabulation in Section D thereof:

"133% 1 October 1951 30 September 1952."

This amendment makes no change in the estimated cost of Task Order Nonr-263(02).

Recd Copy
Its
5/7

NAVEXOS 2185-17-2 (Rev. 3-51)

CONTRACT NO. Nonr-263(02)

AMENDMENT NO. 2

If the foregoing is acceptable to you, please indicate your acceptance thereof by executing the enclosed two (2) copies of this letter, and return them to the Office of Naval Research, whereupon this letter and your acceptance thereof will constitute this an amendment to the above numbered Task Order.

Sincerely yours,

Contracting Officer
Office of Naval Research
Department of the Navy

ACCEPTED THE TRUSTEES OF THE STEVENS INSTITUTE OF TECHNOLOGY
(Contractor)

By_____

TITLE_____

WITNESSES:

(1)_____

(2)_____

NOTE: In the case of a corporation witnesses are not required but certificate below must be completed.

CERTIFICATE

I, , certify that I am the Secretary of the corporation named as Contractor in the foregoing amendment; that , who signed said amendment on behalf of the Contractor was then of said corporation; that said amendment was duly signed for and in behalf of said corporation by authority of its governing body and is within the scope of its corporate powers.

_____
(Signature of person certifying)

(CORPORATE SEAL)

CONTRACT DIVISION ROUTE SHEET

ACCOUNTING CHANGE

CONTRACT NUMBER: Nonr-263(02) TASK ORDER: AMENDMENT NUMBER: 2

	Date and Initials	Comments
	5/24/52 ABW	Proposed by Res Bd 4-28-52
	4/18/52 lat	Dylek Sas 4/28/52
	BW 4-29 MD 5/2	case given to Mr. Thornton
	5/2 [illegible]	
	MD 5/2 mailed	
		No Cost

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

Contract Number: NonR-263(02)
~~Task Order:~~
Amendment Number: 2

ONR: 263: BAT:
NonR-263(02)
(Mathematical Sciences Division)

The Trustees of the Stevens
Institute of Technology
Hoboken, New Jersey

Gentlemen:

To establish the overhead rate applicable under Task Order NonR-263(02) for the period from 1 October 1951 to 30 September 1952, in accordance with the provisions of Section 24(a)(7) of the contract, said Task Order, as amended, is hereby further amended by adding the following under the tabulation in Section D thereof:

" 133 % 1 October 1951 30 September 1952 "

This amendment makes no change in the estimated cost of Task Order NonR-263(02).

ONR:268:WRM:bg
Nonr-263(02)
Ser

3341

From: Chief of Naval Research
To: Director, Office of Naval Research, New York, New York

FEB 0 1952

Subj: Contract Nonr-263(02), Stevens Institute of Technology; subcontract with Askania Regulator Company

Ref: (a) ONR New York ltr Ser 210 to ONR (Code 268) dtd 7 Jan 1952

1. Authorization is hereby given for your approval of a subcontract with Askania Regulator Company containing a patent rights clause permitting the subcontractor to retain title to foreign patents. Buchaan approval may be given to Stevens Institute under Section 27(f) of subject contract. Such modified patent rights clause if approved should contain a provision, however, for granting to the Government an irrevocable nonexclusive and royalty-free license to practice for governmental purposes any inventions covered by foreign patents.

2. With respect to the type of contract to be employed, this office has been advised that Askania Regulator Company will now accept a cost-plus-fixed-fee rather than a time and materials subcontract.

WENDELL R. MANGIS
By direction

NR-3

OFFICE OF NAVAL RESEARCH, NEW YORK

346 BROADWAY

NEW YORK 13, NEW YORK

ADDRESS REPLY TO COMMANDING OFFICER AND REFER TO:

L4-3/2A/CHE:sw
Nonr-26302
Serial No. 1046

6 February 1952

25
file

Mr. G. Morris
Stevens Institute of Technology
Hoboken, New Jersey

Dear Mr. Morris:

Further reference is made to your letter of 30 November and the proposed subcontract under Contract Nonr-26302 with Askania Regulator Company, Chicago, Illinois.

This will confirm that the following are acceptable to the Office of Naval Research:

(1) The patent conditions specified in your 30 November 1951 letter.
(2) A subcontract with Askania in accordance with Part 2, Section 15, Supply and Research Contracts with Commercial Organizations, of the Armed Services Procurement Regulations.

This letter supplements our letter of 31 July 1951 which approved this subcontract as being technically necessary to the work under Contract Nonr-26302. The total amount approved remains $15,000, inclusive of estimated cost and fee. The costs involved in this subcontract will be subject to audit and acceptance by the Cost Inspection Service.

Very truly yours,

C. H. EDWARDS
Head, Contract Department

Copy to:
SCI EA
Code 268, ONR Wash

OFFICE OF NAVAL RESEARCH, NEW YORK
346 BROADWAY
NEW YORK 13, NEW YORK

ADDRESS REPLY TO COMMANDING OFFICER AND REFER TO:

Patents
L4-3/1P/Nonr-26300
(RBJ:bf)

Serial No. 212
7 January 1952

MEMORANDUM

From: Head Patents Division
To: Head Contract Division

Subj: Contract Nonr-263(00) (Stevens Institute Technology), Patent Provisions of Proposed Subcontract With Askania Regulator Co.

Ref: (a) ltr from Experimental Towing Tank Stevens Institute of Technology, Hoboken, N.J. dtd 30 Nov. 1951 to ONR, NY
(b) Executive Order 9865, June 14, 1947

1. Reference (a) states that the proposed subcontractor, Askania Regulator Co. of Chicago "objected to the patent clause" because Askania desires to retain foreign title but is willing to give a royalty-free non-exclusive license for this country to the United States Government.

2. Subject contract, Section 28, reads

"FOREIGN PATENT RIGHTS

The Contractor agrees,.... to grant to the Government, upon request, title to the foreign rights in which subject invention (as defined in the clause of this contract entitled 'PATENT RIGHTS')".

The definition given in Section 27 of subject contract is as follows:

"PATENT RIGHTS

(a).....

(i) The term "Subject Invention" means any invention, improvement or discovery (whether or not patentable) conceived or first actually reduced to practice either (A) in the performance of the experimental, developmental or research work called for under this contract".

- -

3. Subject contract, Section 27(f) states

> "The Contractor agrees....to negotiate for the inclusion in any subcontract hereunder....of this patent rights clause or one approved by the Contracting Officer. In the event of refusal by a subcontractor....Contractor shall obtain the written authorization of the Contracting Officer....to proceed with the subcontract and.... negotiation....of a mutually acceptable patent rights clause".

It may be that ONR, Washington, will consider that such written authorization in this case covering foreign rights is sufficient and if so, ONR, N.Y. should request such written authorization be given to the Contractor permitting Contractor to enter into a subcontract under which Askania will retain foreign title.

4. However, because subject contract, Section 27(f) refers to "this" patent rights clause, it may be that ONR, Washington will consider that such a written authorization cannot be made with respect to the foreign patent rights clause (Section 28), which requires contractor, upon request, to grant title to foreign rights, and if ONR, Washington is of such opinion, ONR, N.Y. should request that subject contract be amended to include a clause permitting written authorization similar to that in Section 27, or, that subject contract be amended to except from Section 28 foreign rights in connection with regulators of the kind to be covered by the proposed subcontract.

5. The request of paragraphs 2 and 3 are based upon the fact that reference (b) in paragraph 1, states

> "All Government departments and agencies shall, <u>whenever practicable</u>, acquire the right to file foreign patent applications on inventions resulting from research conducted or financed by the Government." (underlining ours).

and further, in view of the fact that it is well-known that the Government does not have funds to file foreign patent applications and that heretofore in only a few, very exceptional cases has there been any foreign patent application filed by the U.S. Government.

RODERICK B. JONES

ONR-3

210

OFFICE OF NAVAL RESEARCH, NEW YORK

346 BROADWAY

NEW YORK 13, NEW YORK

ADDRESS REPLY TO COMMANDING OFFICER AND REFER TO:

L4-3/2A/CHE:sw
Nonr-26302
Serial No. 210

7 January 1952

From: Commanding Officer
To: Chief of Naval Research
Attn: Code 268

25216

Subj: Contract Nonr-263, Task Order 2, Stevens Institute of Technology; subcontract with Askania Regulator Company

Ref: (a) Telcon btwn Mr. Mangis & Mr. Edwards on 5 January 1951

Encl: (1) Stevens Inst (G.R. Morris) ltr of 30 Nov 1951
(2) ONR NY inter-office (Dr. Jones) memo re patent clause on Askania subcontract, ser 212 of 7 January 1952

1. Enclosure (1) includes reference to patent clauses for a proposed subcontract with Askania Regulator Company. The comments of the Patent Department, Office of Naval Research, New York, as regards this matter, are contained in enclosure (2). In accordance with enclosure (2), instructions are requested.

2. The difficulties with the rates on the subcontract were discussed with Code 268 through reference (a). As a result thereof, Stevens is considering the use of a time and material type subcontract which would contain provision for use of appropriate provisional overhead rates. Neither Stevens nor, to our knowledge, Askania has indicated a willingness to use a cost-plus-fixed-fee type subcontract.

C. H. EDWARDS
By direction

Copy to:
SCI EA (w/cy encl (1))

EXPERIMENTAL TOWING TANK
STEVENS INSTITUTE OF TECHNOLOGY
HOBOKEN, NEW JERSEY

30 November 1951

Commanding Officer
Office of Naval Research
346 Broadway
New York, New York

SUBJECT: Contract Nonr-263(02)

REFERENCE: a) Stevens letter of 20 July 1951
b) Stevens letter of 23 July 1951
c) ONR letter of 31 July 1951
L4-3/2A/JJS:sb
Nonr-263(02)
Serial 5189

Dear Sir:

Under reference a) we requested approval for the placement of a purchase order with Askania Regulator Company of Chicago in behalf of the subject contract and supplemented that letter with reference b). Reference c) gave qualified approval for the placement of the purchase order.

The purchase order was then placed with Askania and copies were given to the Bureau of Supplies and Accounts.

Askania objected to the patent clause on the basis that they desire to retain foreign title together with the right to license in and to foreign countries but are willing to

a) grant to the Government free of charge non-exclusive rights together with the right to sublicense third parties for Government and defense work,
b) notify the Government of any negotiations with foreign countries or foreign concerns with regard to licensing under any patents resulting from performance of the contract,
c) desist from disclosing any information classified or not if this appears in the interest of the Government.

Askania has maintained this position and refuses to enter into a subcontract unless this is acceptable to the Government.

Commanding Officer,
Office of Naval Research

30 November 1951

The Bureau of Supplies and Accounts objected to the purchase order as drawn on the contention that the labor rates named were too high. This was on the basis of information supplied to them by the Navy Cost Inspector, Chicago. The Bureau of Supplies and Accounts also objected to the method of handling the costs of travel, subsistence, supplies and materials. The Bureau implied verbally that they would be willing to accept other labor rates considerably lower than those requested by Askania and that travel, subsistence, materials and supplies should be charged for without mark-up as the suggested rates, even though lower, were in the Bureau's opinion sufficient to cover profit on these items.

The above mentioned suggested rates were submitted to Askania, together with other alternate methods of arriving at a contractual understanding. All of these have now been rejected by Askania who maintains that the rates they have proposed to us are reasonable.

Your contractor is in an untenable position and the work under the contract is delayed. We applied for approval in accordance with the terms of the contract and were given a qualified approval equivalent to a mere recognition of the technical advisability of placing a purchase order, which in turn is objected to by the Bureau of Supplies and Accounts based principally on matters of fact of which we as contractors have no knowledge. The question of foreign patents of course is a matter of governmental policy.

Your consideration of the problems involved is requested.

Yours very truly,

STEVENS INSTITUTE OF TECHNOLOGY
Experimental Towing Tank

George R. Morris
Financial Officer

GRM:jsd

ONR:265:FKD
Nonr-263(00)

The Trustees of the Stevens
Institute of Technology
Hoboken, New Jersey

Subject: Research Contracts - Nonr-263(00), Amend. 1, Nonr-263(01), Amend. 1 and Nonr-263(02), Amend. 1.

Gentlemen:

The subject documents forwarded to you for signature on 26 November 1951, 26 November 1951 and 9 November 1951 have not been received in this office. It is requested that they be signed and returned to this Office, Attn: Code 265.

Sincerely yours,

CONTI	TASK ORDER	MENT
Nonr-263(02)	----	1

Contractor: Stevens Institute of Technology

Code	Date and Initials	Comments
~~262K~~ 268	10/26/51	Amendment to provide computing
262K	10/26	services
262J		
262		
106	11/20/51	
~~XXX~~-268		
262K Proofed: [illegible]	Read by: [illegible] 11-8-51	
Recorded	In 10/31 Out 11/8/51	
262J (Page Check)		
260A		
265	11-8 11/9/51	
260	11/8/51	
265	11/9 mailed	
		Hold until Amendt 3 to
		basic is mailed
		(Report of Obligation

The following information should be forwarded to the Branch Office:

(1) Clearance Memorandum

(2) Other (Indicate)

(Signature)

1/51

ıformation below applies only to the document which this accompanies)

ıtractor Stevens Institute of Technology Amount ----

ıtract No. Nonr-263(02) T.O. --- Amend. 1

': (check one)

X Research, (Reports)

Development of training devices

Scientific Equipment

Other _____ (state)

be dated ~~XXXXXXXXXXXXXXX~~

currently
(if applicable, state reason below)

Type of Contract (check one)

___ (1) Fixed Price
___ (2) Fixed Price, including price redetermination
___ (2a) Fixed Price, with downward revision only
___ (3) Fixed Price, including price escalation
___ (4) Fixed Price, incentive
___ (5) Cost
___ (6) Cost Plus Fixed Fee
___ (7) Time and Material
___ (8) Other (specify) _____

lar value being subcontracted.

lar volume being subcontracted to Small Business.

	YES
Statement from Contractor re use of a company or person to solicit	
Have ☐ Have not ☐	
Planned Producer	
Planned Item	
Contracting Officer's Statement	
Business Clearance (Navexos-2760)	
Method of Contracting D & F (cost)	
Is this contract susceptible to Small Business?	
Contract with Small Business	
Government Furnished Material	
Renegotiation applicable to these funds	
Naval Working Fund	
Classified	
Subject to Vinson-Trammel Act	
Subject to Walsh-Healey Act	
Facilities Clearance	

Denied 1/23/52 Cancelled

hority under A. S. P. R.

authority other than A. S. P. R., state

11/9

Wendell R Mangis "Cancelled"
(Negotiator)
WENDELL R. MANGIS

3/51

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

CONTRACT NUMBER: Nonr-263(02)
AMENDMENT NUMBER: 1

ONR:268:WRM:
Nonr-263(02)
(Mathematical Sciences
Division)

The Trustees of the Stevens
Institute of Technology
Hoboken, New Jersey

Gentlemen:

To establish the "use" charge applicable under Task Order Nonr-263(02) for the period 1 February 1951 to 30 January 1952, in accordance with the provisions of Section 24(a)(9) of Contract Nonr-263(00), said Task Order Nonr-263(02) is hereby amended by adding the following new section:

"SECTION G - In accordance with the provisions of subsection 24(a)(9) of the contract, a use charge for the period or periods specified below is hereby established for 'Maddida' special purpose computer equipment for work under this Task Order:

Amount Per Hour Machine Usage	Period for Which Applied From	To
$7.50	1 February 1951	30 January 1952."

This amendment makes no change in the estimated cost of Task Order N6onr-24705.

APPROVED: Wendell R Manning

DATE: 10/26/51

DISRIBUTION LIST - FINAL

Date of Document: ____ N6ori-263/62

Additional copies of all Research and Development Contracts — ~~2 copies~~

Chief, Reconciliation and Clearance Subdivision, Navy Audit Branch, General Accounting Office, 1901 East 13th St., Cleveland, Ohio — 1 original

GAO, Washington, D. C. (On all cost-plus fixed fee or cost without fee) — 1 original

6/12/51

D&F (To GAO) if required) — 1 copy

InsMat (or BAR) — ~~3 copies~~

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with 3rd Naval District

Naval Working Fund Letter (If required) — 1 copy

Bureau of Supplies and Accounts, Code AP-2, Room 1534 Arlington Annex — 1 copy

Bureau of Supplies and Accounts, Code AP-111, Arlington Annex — 1 copy

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Contractor — ~~6~~ 2 copies

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Special Devices Liaison - Room T3-1815 - Miss Carr — 1 copy

Naval Research Laboratory, Anacostia, Washington 20, D. C. Attn: Mr. Sanders — 6 copies

Fiscal Sections - To be listed on DRO

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BuOrd (Designate cognizant NRAO on this copy)	1 copy
BuAer	1 copy
BuMed	1 copy
BuPers	1 copy
BuYds and Docks	1 copy
Wright-Patterson Air Force Base	1 copy
Insurance Branch, EXOS, Mr. Shetley, Room T3-1715 (On all Est. Cost Contracts)	1 copy
Cost Inspection Service, Room 0211 - Main Navy, BuSandA Attn: Mr. R. C. Kiser (on all Est. Cost Contracts)	5 copies
Mr. Pace, Room 1820 (All unclassified contracts, etc.)	1 copy
Mr. Harding, Room 2810	1 copy
Project Status	1 copy

Cognizant Section of ONR

Natural Sciences	Biological Sciences
Earth Sciences	Human Resources Division
Naval Sciences	Mathematical Sciences (Section) (Code)
Physical Sciences	1 copy

SPECIAL REQUESTS

All documents having BuMed Appropriations Finances Division, Naval Medical Center, Building 2 Room 214, Bethesda, Maryland, Attn: Miss Judd	1 copy
BuMed, Director, Research Division	1 copy
All documents having BuShips Appropriations BuShips, Code 363, Attn: Miss Frechette	1 copy
All documents relating to the contracts listed below Office of Fiscal Director Room 4B683, Pentagon Building Attn: Mr. Nichols	1 copy

MIT - N5ori-60 and Task Order I thereunder
NOp 6964 and Task Order I thereunder
N5ori-78 and all Task Orders thereunder
N6ori-126
N6ori-241
N6ori-110
N6onr-271
N6ori-131
N6onr-231
N6ori-102
N6onr-244
N7onr-321 (Stanford Research)

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
CONTRACT NUMBER: Nonr-263(02)

RESEARCH AND DEVELOPMENT TASK ORDER

CONTRACTOR: The Trustees of the Stevens Institute of Technology

AUTHORITY: NR 341-009/1-19-51 (Mathematical Sciences Division)

APPROPRIATION: 17X1317.10 Research Navy (Expenditure Account 46110) (Object Classification 079) Program Number 32000

ESTIMATED COST: $39,500.00

This Task Order is established under, and constitutes a part of, Contract Nonr-263(00) which sets forth the basic contract provisions applicable hereto. In case of any conflict between the provisions of said Contract Nonr-263(00) and the provisions hereof, the latter shall control.

SECTION A - The Contractor shall use his best efforts to furnish the necessary personnel and facilities for and, in accordance with any instructions issued by the Scientific Officer or his authorized representative, shall conduct research and investigation of new approaches to the theory and design of automatic controls of improved performances. Such research and investigation shall include, but not necessarily be limited to:

(1) development of the theory of saturated controls obeying non-linear control equations which optimize performance;

(2) [illegible]rative predictive schemes in control problems; and

(3) determination of the feasibility of the above approaches to the improvement of automatic control performance.

SECTION B - The Scientific Officer under this Task Order is the Head, Mathematics Branch, Mathematical Sciences Division, Office of Naval Research.

SECTION C - The estimated cost of the performance of this Task Order is thirty nine thousand five hundred dollars ($39,500.00).

SECTION D - The percentage to be applied with respect to this Task Order in accordance with the provisions of Section 24(a)(7) of the contract shall be a fixed percentage, in the amount or amounts, and for the period or periods, specified below:

%	Period for which Applied From	To
142%	1 March 1951	30 September 1951.

Recd copy 2 to M Br. + clear. 3/17

CONTRACT NUMBER: Nonr-263(02)

SECTION E - The Contractor shall submit final reports upon completion of work hereunder, making full disclosure of all research conducted, and shall submit such other reports as are required by the Scientific Officer.

SECTION F - The performance of work under this Task Order shall commence on 1 March 1951, and shall be completed on 29 February 1952.

CONTRACT NUMBER: Nonr-263(02)

This negotiated Task Order is entered into pursuant to the provisions of Section 2(c)1 of the Armed Services Procurement Act of 1947 (Public Law 413, 80th Congress), and any required determination and findings with respect thereto has been made.

IN WITNESS WHEREOF the parties hereto have executed this Task Order as of the day and year first above written.

UNITED STATES OF AMERICA

BY_____

Contracting Officer
Office of Naval Research
Department of the Navy

WITNESSES:

(1)_____

(2)_____

NOTE: In the case of a corporation witnesses are not required but certificate below must be completed.

_____
Contractor

By_____

TITLE_____

_____
(Business address of Contractor)

CERTIFICATE

I, _____, certify that I am the Secretary of the corporation named as Contractor in the foregoing Task Order that _____, who signed said Task Order on behalf of the Contractor was then _____ of said corporation; that said Task Order was duly signed for and in behalf of said corporation by authority of its governing body and is within the scope of its corporate powers.

_____
(Signature of person certifying)

(CORPORATE SEAL)

EXPERIMENTAL TOWING TANK

STEVENS INSTITUTE OF TECHNOLOGY

711 HUDSON STREET HOBOKEN, NEW JERSEY

TELEPHONE HOBOKEN 3-8080

KENNETH S. M. DAVIDSON, DIRECTOR
ALLAN B. MURRAY, ASSISTANT DIRECTOR

HUGH W. MAC DONALD, EXECUTIVE DIRECTOR
GEORGE R. MORRIS, FINANCIAL OFFICER

26 March 1951

Department of the Navy
Office of Naval Research
Washington 25, D. C.

Attention: Code 265

Subject: Contract Nonr-26302

Reference A: ONR Letter of 3/23/51 - Reference ONR:265:NED
Nonr-263(02)

Reference B: ETT Letter of 2/27/51

Gentlemen:

The subject contract which was enclosed with Reference A is held pending reply to Reference B, which raised questions relating to the basic contract.

Yours very truly,

EXPERIMENTAL TOWING TANK
Stevens Institute of Technology

George R. Morris

George R. Morris
Financial Officer

GRM:MR

2/13

CONTRACT TASK ORDER AMENDMENT

Nonr-263(02)

Contractor: Stevens Institute of Technology

Code	Date and Initials	Comments
262- E	2/5/51	
262K	2/6 R.M.	
262J	2/15/51 B	263(01) is in Ditto. I borrow the case from NRS to check this (02). OK with them.
262	2/13 Ref	
106	2/23/51	
262-		
262K	Proofed: PAL Read by: TBS 2/28/51	
	Recorded In / Out 3/15 R.M.	
262J (Page Check)		
262A		
265	BW 3-15 3/17	
260	3/13	
265	NR 3/13 mailed	

(Report of Obligation 4548) 2/6

The following information should be forwarded to the Branch Office:

(1) Clearance Memorandum Dtd. 2 February 1951

(2) Other (indicate)

Starts 3/1/51

9/21/49

J. RICHMAN (Signature)

(Information below applies only to the document which it accompanies.)

Contractor The Trustees of the Stevens Institute of Technology Amount $39,500.00

Contract Number Nonr-263(02) T. O. _____ Amend. _____

For: (check one)
- [X] Research
- [ ] Development of training devices
- [ ] Scientific Equipment
- [ ] Other _____ (state)

To be dated not later than 1 March 1951 (if applicable, state reason below)

YES		NO
X	Statement from Contractor re use of a company or person (other than a full time employee) to solicit or secure this contract	
	Have [ ] Have not [X]	
	Negotiation Clearance (Navexos-2759)	X
	Negotiation D & F	X
	Contracting Officer's Statement	X
	Business Clearance (Navexos-2760)	X
X	Method of Contracting D & F (cost) #3971	
	Advance Payment Clearance	X
	Advance Payment D & F	X
	Contract with Small Business	X
	Government Furnished Material	X
	Renegotiation applicable to these funds	X
	Naval Working Fund	X
	Classified	X
	Subject to Vinson-Trammel Act	X
	Subject to Walsh-Healey Act	X

Authority under A.S.P.R. Section 3.201

If authority other than A.S.P.R., state _____

8/25/50 3/13

J. RICHMAN (Negotiator)

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
WASHINGTON 25, D. C.

IN REPLY REFER TO
ONR:265:NED
Nonr-263(02)

The Trustees of the
Stevens Institute of Technology
711 Hudson Street
Hoboken, New Jersey

23 MAR 1951

Subject: Research Contract Nonr-263(02).

Gentlemen:

Three copies of the subject task order have been executed by the Government and are forwarded herewith for execution by you. It is requested that two of the executed copies be returned to this Office, Attention: Code 265. The third executed copy of the task order may be retained by you for information and files.

Your prompt advice will be appreciated if for any reason you cannot return the two execution copies within ten days.

Sincerely yours,

J. A. [illegible] Hall
Head, Control - Distribution Branch
By direction of
Chief of Naval Research

Encls:
1. Three (3) copies of the subject task order
2. Instructions Respecting Execution

CC: CO, ONR - New York Br.
Code 265
3-16-51

51 28174

SUPPLEMENTAL CLEARANCE MEMORANDUM

NR 341-009/1-19-51
Contract Nonr-263(02)

Unclassified
22 March 1951

The Trustees of the Stevens
Institute of Technology
711 Hudson Street
Hoboken, New Jersey

A breakdown of the item of $15,000.00, in respect to Askania Regulator Company, is as follows:

Shop Labor	$ 200.00	
Shop Overhead, 130%	260.00	
Engineering Salaries	3,753.00	
Engineering Overhead, 140%	5,254.00	
Miscellaneous Materials	1,200.00	
Travel	2,035.00	-- (Trips between Chicago, Hoboken, etc.)
Total	$12,702.00	
General and Administrative Charge, 10%	1,270.00	
	$13,972.00	
Profit, 10%	1,397.00	
	$15,369.00	

ROUNDED OFF TO $15,000.00

CLEARANCE MEMORANDUM

NR 341-009/1-19-51
Contract Nonr-263(02)

Unclassified
2 February 1951

The Trustees of the Stevens
Institute of Technology
711 Hudson Street
Hoboken, New Jersey

1. Negotiations

Under date of 4 December 1950, the Trustees of the Stevens Institute of Technology (hereinafter referred to as the Contractor) submitted a written proposal relative to a Study of Automatically Programmed Control Systems. Attached to, and forming a part of this proposal, it submitted an estimate of costs relative to the proposed extension. Thereafter, on 29 January 1951, it submitted a revised estimate of costs in respect to the proposed research. From the technical point of view, Contractor's proposal has received the approval of the Head, Mathematics Branch, Mathematical Sciences Division, Office of Naval Research.

2. Description of the Work

It is proposed that Contractor will conduct investigations of new approaches to the theory and design of automatic controls of improved performance. The objective will be to develop the theories of saturated controls obeying non-linear control equations which optimize performance, to investigate iterative predictive schemes in control problems, and to determine the feasibility of these two approaches to the improvement of automatic control performance.

3. Information Regarding the Contractor

Personnel at the Experimental Towing Tank, Stevens Institute of Technology, have in the past carried on successfully studies concerning the influence of stability and maneuverability on control system design. These studies have suggested the research to be conducted under this task for which the Stevens Institute group is therefore particularly qualified.

4. Analysis of the Costs

The following is an analysis of the estimated cost:

	Hours	Rate*	Amount
Engineers	1075	3.48	$3,741.00
Chief Technical Assistants	1535	1.91	2,931.85
Miscellaneous Laboratory Assistants	1790	1.24	2,219.60
Salary			8,892.45
Overhead 142%			12,627.28

	Hours	Rate*	Amount
Mathematical Services			$1,200.00
Travel (principally laison with Askania at Chicago)			800.00
Misc. materials and expense including trans. of computing equipment			1,000.00
Askania Regulator Co. (Subcontract for design and building of automatic controls systems. Also for possibilty studies and the practical application - see below)			15,000.00
		TOTAL	$39,519.73
Proposal rounded to $39,500.00			

* Average Rates for purpose of this tabulation only

The theoretical research on both the non-linear control equation approach and the iterative predictor approach will be undertaken at Stevens Institute, and will use the computing facilities and such other facilities owned by Stevens Institute as may be necessary.

The technical staff of the Experimental Towing Tank will be supplemented for the purposes of this contract by the employment of one or more members of the Differential Equations Project at Princeton under Dr. S. Lefschets.

The experimental studies of the iterative predictor approach and all design and feasibility studies will be conducted by the staff of Askania Regulator Co. at Chicago.

The Experimental Towing Tank will provide liaison, coordination, overall administration and direction, and will prepare all reports.

5. Overhead

As above indicated, overhead is computed at 142% of wages and salaries, This rate has been agreed upon with Contractor to and including 30 September 1951, and accordingly, the rate will be fixed to that date. Thereafter, the same rate will apply provisionally until further fixed or otherwise modified.

6. Period of Performance

It is proposed that work under this Task Order shall commence on 1 March 1951, and shall be completed on 29 February 1952.

7. Other Pertinent Information

This Task Order is being written under the new A Type basic contract. It is not

being written as a fixed price contract because of the indefiniteness, the nature and the various amounts estimated for mathematical services, miscellaneous materials, etc. and subcontracting.

In its letter of 29 January 1951, Contractor has set forth the required statement that it has not employed or retained a company or person other than a full time employee to solicit or secure this contract.

8. Authority

Authority for the negotiation of this contract is to be found in Section 2(c)(1) of the Armed Services Procurement Act of 1947.

9. Reasonableness

In the opinion of the undersigned, the terms and conditions here and above set forth appear to be fair, reasonable, and in the interest of the Government.

J. RICHMAN

~~(Task Order-A Type for new Basics)~~

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
CONTRACT NUMBER: N onr-263(02)

RESEARCH AND DEVELOPMENT TASK ORDER

CONTRACTOR: **The Trustees of the Stevens Institute of Technology**

AUTHORITY: **NR 341-009/1-19-51** (Mathematical Sciences Division)

APPROPRIATION: **17X1317.10 Research Navy (Expenditure Account 46110) (Object Classification 079) Program Number 32000**

ESTIMATED COST: **$39,500.00**

This Task Order is established under, and constitutes a part of, ~~Contract~~ N onr- 263(00) which sets forth the basic contract provisions applicable hereto. In case of any conflict between the provisions of said Contract N onr- 263(00) and the provisions hereof, the latter shall control.

SECTION **A**- The Contractor shall use his best efforts to furnish the necessary personnel and facilities for and, in accordance with any instructions issued by the Scientific Officer or his authorized representative, shall conduct **research and investigation of new approaches to the theory and design of automatic controls of improved performances. Such research and investigation shall include, but not necessarily be limited to:**

(1) development of the theory of saturated controls obeying non-linear control equations which optimize performance;
(2) iterative predictive schemes in control problems; and
(3) determination of the feasibility of the above approaches to the improvement of automatic control performance.

SECTION **B** - The Scientific Officer under this Task Order is the Head, **Mathematics** Branch, **Mathematical Sciences** Division, Office of Naval Research.

SECTION **C** - The estimated cost of the performance of this Task Order is **thirty nine thousand five hundred dollars ($39,500.00).**

SECTION **D** - The percentage to be applied with respect to this Task Order in accordance with the provisions of Section 4(a)(7) of the contract shall be a **fixed percentage, in the amount or amounts, and for the period or periods, specified below:**

%	Period for which Applied From	To
12½	1 March 1951	~~29 February 1952~~ 30 September 1951

CONTRACT NUMBER: N onr- 263(02)

SECTION E - The Contractor shall submit final reports upon completion of work hereunder, making full disclosure of all research conducted, and shall submit such other reports as are required by the Scientific Officer.

SECTION F - The performance of work under this Task Order shall commence on 1 March 1951 , and shall be completed on 29 February 1952 .

APPROVED BY:

Date: 5 Feb. 1951

Arthur Grad
Scientific Officer

J. Richman, Negotiator

/jl

MENT JUSTIFICATION

'70 (9-48)

OFFICE OF NAVAL RESEARCH

RESEARCH GROUP

Rickover

OPERATIONAL REQUIREMENT AD 09401

(Other)

(Submit Original and four copies) 3971

ect NR 341 000

SECURITY CLASSIFICATION	TYPE PROJECT	
UNCLASSIFIED	[X] NEW	[ ] RE-NEWAL

xxxxxxxxSubtask 1 009

CONTRACT NO. Nonr 263 (02)

TASK ORDER

DATE 19 Jan 1951

IFIC OFFICER

F. Joachim Weyl 64644

AND ADDRESS

ens Institute of Technology

ken, New Jersey

INVESTIGATOR

eth S. M. Davidson

TLE

y of Automatically Programmed

rol Systems

Do not write in this space

P.D. NO.	PROGRAM NO. 32000
APPROPRIATION(S) 17X1317.10 RESEARCH NAVY	
OBJECT CLASS 079	EXPENDITURE ACCOUNT NO. 46110

ESTIMATED MAN YEARS: PROF. 1 GRAD. STUD. 2

ESTIMATED COMPLETION DATE TOTAL PROJECT: 1 March 1953

ANY GOVERNMENT AGENCY DO K IN THE TIME SPECIFIED? [ ] YES [X] NO

REPORTS REQUIRED (Quarterly, monthly, etc.)

JS

ITIFIC OR TECHNICAL as justified

RS: AS ESTED OR-

FISCAL ESTIMATES		THIS COMMITMENT (EST.)	
PAST 1947	$	BASIC	$
PAST 1948	$	APPLIED	$ 39,500.00
FUTURE 1950	$	COST 51 ONR-FUNDS	$ 39,500.00
FUTURE 1951	$	OTHER	$

DURATION FROM 1 March 1951 TO 31 December 1951 29 Feb 1952

THIS CONTRACTOR SELECTED?

onnel at the Experimental Towing Tank, Stevens Institute of Technology, in the past carried on successfuly studies concerning the influence ability and maneuverability on control system design. These es have suggested the research to be conducted under this task for the Stevens Institute group is therefore particularly qualified.

ED AGENCIES CORRESPONDENCE NOT ATTACHED, ETC.:

BuShips

NADC, Johnsville, Pa.

It is requested that the following or similar language be placed on the resulting obligation document. This contract to be treated for Navy cost purposes as a formal ... the amount of ...

Funds Committed

Amt 39,500.00

Date 1/25/51 By

F. Joachim Weyl

Branch) Mathematics

Mina Rees

OR (Division) Mathematical Sciences

(3) T. J. Killian

SCIENCE DIRECTOR, RESEARCH

(4) Emanuel R. Piore

ASST. CHIEF FOR RESEARCH

(5) C. M. Bolster

DEPUTY AND ASSISTANT CHIEF OF NAVAL RESEARCH

ES: (a) Original copy of proposal & contractor's business office approval
(b) Justification and Brief (Use reverse side)

B-5112

JUSTIFICATION AND BRIEF

1 009

(1) Scientific Justification (2) Brief of Project (3) Possible Naval Application

The investigations to be carried out under this task are concerned automatic control systems for the execution of major maneuvers. distinguishes them clearly from systems designed for the purpose of e-keeping where it is merely a matter of correcting for the com- ively minor random disturbances caused by a inhomogeneous or noisy onment. The performance of the type of control system to be in- gated must be evaluated from such viewpoints as the execution of a ed maneuver in least time or with least effort, etc. This is in ast to course-keeping type of controls whose aim is generally the ization of mean square errors. The proposed viewpoint appears to new one in the field of control system development and certainly nts careful investigation. The Stevens Institute of Technology be supported in this study by engineers from the Askania Regula- ompany and by the Mathematics Department at Princeton University ying respectively practical advice and the assurance of theoretical ness.

wo particular types of automatically programmed control systems are studied as to their feasibility. The first one is centered on an gue computing device which from known instantaneous conditions and sumed future program predicts rapidly the remainder of the maneuver. e prediction differs from the desired outcome a systematic correction e control program is made and the computation repeated with the nitial conditions. In this fashion those parts of the control am lying in the immediate future will be defined with greater and er precision, and will be executed as real time catches up with The second type of system envisages the preliminary computation timum control sequences for a sufficiently large family of repre- l maneuvers. The relation which is thus established between the ed maneuver and required control command sequence is then to be ed from the viewpoint of realizing it in a compact analogue device function might be described as that of looking in a table of pos- command sequences for the one corresponding to the maneuver to be ted. Since in particular the requirement of maneuvers in minimum o will generally require that the controls are used to saturation rrent study will work essentially with black-white controls.

The possible naval applications are found in any situation where maneuvers have to be executed with such accuracy in timing as to out the use of human operators or under conditions where no human tors are on hand. Example of this can be found in the maneuver gh speed aircraft from tally-ho to the point of firing a guided le at a target; in the maneuver of a guided missile from the nt of release to the instant when homing devices take over the nce control; in the rapid execution of evasive maneuvers by high aircraft and in depth changes on the part of high speed submarines.

Operational Requirement: AD 09401.

EXPERIMENTAL TOWING TANK
STEVENS INSTITUTE OF TECHNOLOGY
711 HUDSON STREET HOBOKEN, NEW JERSEY

KENNETH S. M. DAVIDSON, DIRECTOR
ALLAN B. MURRAY, ASSISTANT DIRECTOR

HUGH W. MAC DONALD, Executive Director
HOBOKEN 3-8080

29 January 1951

Department of the Navy
Office of Naval Research
Washington 25, D. C.

Attention: Dr. F. J. Weyl

Subject: Revision of Proposal for Research

Reference: Proposal of 4 December 1950 for Research on Investigation of new Approaches to the Theory and Design of Automatic Controls of Improved Performance.

Gentlemen:

This letter represents a reduction to $39500.00 in the amount of the proposal made under the above reference. Under this revision the program proposed in the reference will be pursued to the extent of the funds available. A revised estimated cost breakdown is attached.

The proposed contractor represents that he has not employed or retained a company or person (other than a full-time employee) to solicit or secure this contract, and agrees to furnish information relating thereto as requested by the Contracting Officer.

Very truly yours,

The Trustees of the Stevens
Institute of Technology

Nichol H. Memory, Treasurer

George R. Morris, For the Director

Reference Copy to O.N.R., New York

GRM:MR
Enclosure

1 FEB 1951

EXPERIMENTAL TOWING TANK

Stevens Institute of Technology

Office of Naval Research

Our Proposal of 4 Dec. 1950

REVISED ESTIMATED COST BREAKDOWN 29 Jan. 1951

	Hours	Rate*	Amount
Engineers	1075	3.48	3741.00
Chief Technical Assistants	1535	1.91	2931.85
Instrument Makers, Machinists, Mechanics, etc.	----	----	-- --
Miscellaneous Laboratory Assistants	1790	1.24	2219.60
Salary			8892.45
Overhead 142%			12627.28
Mathematical Services			1200.00
Travel (principally liaison with Askania at Chicago)			800.00
Misc. materials and expense including trans. of computing equipment			1000.00
Askania Regulator Co.			15000.00
Total			39519.73

Proposal Rounded to $39500.00

* Average Rates for purpose of this tabulation only

ONR:432:FJW:mc

19 January 1951

MEMORANDUM

From: Code 432
To: Code 262
Via: Code 430

Subj: Project NR 341 009, Stevens Institute of Technology, fiscal matters concerning

Ref: (a) NR 341 009 PJ dtd 19 Jan 1951 for $39,500.00.

1. The proposal for subject project, accompanying reference (a), calls for $78,000.00. Stevens Institute of Technology has been advised that only $39,500.00 is currently available and is now preparing a revised budget, not exceeding the above amount. The revised proposal will be forwarded as soon as it has reached this Branch.

F. Joachim Weyl

F. JOACHIM WEYL
Head, Mathematics Branch

185735

U.S. NAVY
OFFICE OF NAVAL RESEARCH
New York
346 Broadway
New York 13, N. Y.

Address Reply To
Commanding Officer
And Refer To:

L4-2(Stevens)/IR:fgr
Serial No. 9171

26 December 1950

From: Commanding Officer
To: Chief of Naval Research

Subj: Proposal for Study of Automatic Controls of Improved Performances from Stevens Institute of Technology, Experimental Towing Tank; forwarding of

Encl: (1) Five cys of subject proposal w/original and 4 cys ltr signed by Nichol H. Memory, Treasurer, and George R. Morris, for the Director, dtd 4 Dec 1950
(2) Two cys Scient Div memo to CO ONR NY Ser 9170 dtd 22 Dec 1950

1. Subject proposal is forwarded as enclosure (1). Pertinent comments from representatives of the Office of Naval Research, New York, are contained in enclosure (2).

2. Approval of this proposal is recommended.

W.S. KELLER

5 JAN 1951

L4-2(Stevens)/IR:fgr
Serial No. 9170

MEMORANDUM

22 December 1950

aircraft, guided missiles and other military and naval equipment. Mr. Williamson stated that he is prepared to direct this project into the solution of a specific naval problem, if so requested, and in fact would desire such an assignment.

3. Personnel - The principal investigator is Mr. Robert R. Williamson who has been as staff member of the Experimental Towing Tank for the past six years. Prior to that he did theoretical work on the Manhattan District Project at the University of Chicago. He has worked on Contract N6onr-247, Task Order 5 and other government projects. Prof. Lefschetz is well known for his development of non-linear mathematics and is the director of an ONR task order. The personnel of the Askania Regulator Co. are very experienced in the design of automatic control systems.

4. Budget - The proposal calls for a one year project at a cost of $78,000. Actually, Mr. Williamson expects that the work on this project will take about two years. The items of direct cost at the Experimental Towing Tank appear reasonable. The item for transportation of computing equipment refers to the MADDIDA computer which will be taken to the Askania Co. in Chicago for work on this problem. Almost half of the total cost of the project is the fee to the Askania Regulator Co. No breakdown of this $35,000 charge is given. Mr. Williamson has been asked to obtain such a breakdown of Askania's charge. He indicated that this figure was not necessarily fixed, but could be adjusted if necessary.

5. Recommendation - This project involves mathematical research which can be applied directly to important naval problems. Approval is recommended.

IRVING ROWE

NR-3

OFFICE OF NAVAL RESEARCH, NEW YORK
346 BROADWAY
NEW YORK 13, NEW YORK

ADDRESS REPLY TO COMMANDING OFFICER AND REFER TO:

L4-2(Stevens)/IR:fgr
Serial No. 9170

22 December 1950

MEMORANDUM

From: Electronics Engineer, Scientific Division
To: Commanding Officer

Subj: Proposal for Study of Automatic Controls of Improved Performances from Stevens Institute of Technology, Experimental Towing Tank

1. Scope of Proposal - The purpose of this project is to develop the theory of saturated controls obeying non-linear control equations to optimize control performance. The specific field of application in which the proposed contractor's interest lies, is in the steering and maneuvering control of ships and submarines. However, the principles developed will be of value in all types of control systems. The principal investigator is Robert R. Williamson. His interest in the problem of controls was aroused as the result of his study of the relationship of stability to maneuverability of submarines. This work was done on Contract N6onr-247, Task Order 5, and was reported in Experimental Towing Tank Report No. 389. The minimum time of correction for the error in the control system will be determined by (1) an iterative method and (2) by the theory of games technique. Mr. Williamson appears to feel that the function of his group is to block out the control theory for utilization in the field of hydrodynamics, and to let others carry on more generalized applications. In order to obtain theoretical and practical assistance, and at the same time to interest other groups in this subject, he has obtained the cooperation of the Mathematics Department at Princeton and of the Askania Regulator Co. Prof. Lefschetz of Princeton, well known for work on non-linear mathematics, has agreed to act as a consultant, and a graduate student in his department will be employed for part-time work on this project, in particular, to check the mathematical rigor of the work. The Askania Regulator Co. has much practical experience in designing and building automatic control systems. That company will check the practical feasibility of the solutions. They possess a Philbrick calculator, which will be used in this work. In addition, the Experimental Towing Tank is obtaining a Northrup MADDIDA calculator, a very flexible type of differential analyzer. This is transportable, and will be taken to Chicago for work in cooperation with the Askania engineers.

2. Naval Applicability - The results of this project would be of obvious naval applicability in the design of control systems for ships, submarines,

EXPERIMENTAL TOWING TANK
STEVENS INSTITUTE OF TECHNOLOGY
711 HUDSON STREET HOBOKEN, NEW JERSEY

KENNETH S. M. DAVIDSON, DIRECTOR
ALLAN B. MURRAY, ASSISTANT DIRECTOR

HUGH W. MAC DONALD, Executive Director
HOBOKEN 3-8080

4 December 1950

Chief of Naval Research
Office of Naval Research
Department of the Navy
Washington 25, D. C.

ATTENTION: Dr. J. Weyl

VIA: Office of Naval Research, New York

SUBJECT: Proposal for Research on Investigation of new Approaches to the Theory and Design of Automatic Controls of Improved Performance.

Gentlemen:

As per recent discussions between Dr. Weyl and our Mr. Williamson, we enclose herewith our proposal on the above subject in the amount of $78,000.00. For your convenience we also enclose in further detail, a discussion supplemented by an appendix and charts.

The proposed contractor represents that he has not employed or retained a company or person (other than a full-time employee) to solicit or secure this contract, and agrees to furnish information relating thereto as requested by the Contracting Officer.

Very truly yours,

The Trustees of the Stevens
Institute of Technology

Nichol H. Memory, Treasurer

George R. Morris, for the Director

GRM:wv
enc: Proposal
Discussion
Appendix to Discussion
Est. Cost Breakdown

5 JAN 1951

Advance copy to Dr. Weyl - Mathematical Sciences Section

10344

PROPOSAL FOR RESEARCH

4 Dec. 1950

TO Office of Naval Research

BY Experimental Towing Tank of "The Trustees of the Stevens Institute of Technology", a non-profit educational corporation organized and existing under the laws of the State of New Jersey.

AT Hoboken, New Jersey

TITLE "Investigation of New Approaches to the Theory and Design of Automatic Controls of Improved Performances."

PURPOSE To develop the theory of saturated controls obeying non-linear control equations which optimize performance, to investigate iterative predictive schemes in control problems, and to determine the feasibility of these two approaches to the improvement of automatic control performance.

PROCEDURE The proposed program of research will entail to the extent of the funds available:

1. Theoretical Studies of the problem of saturated controls, from the point of view of Game Theory and the Calculus of Variations, to find optimum non-linear control of a variety of idealized systems.

2. Calculations of performance and stability of the above systems with the optimum non-linear control equations, in the presence of statistical disturbances.

3. Design and Feasibility studies of the control systems developed above.

4. Theoretical and experimental studies of iterative predictors in control systems, and experimental finding of the best rules for iterative operation in at least one practical application of this approach.

5. Simulation of a complete iteration control system and the controlled system, and an evaluation of its performance in the presence of statistical disturbances.

6. Design and feasibility studies of the iterative control system developed in the above research.

PERSONNEL AND FACILITIES TO BE USED:

1. The theoretical research on both the non-linear control equation approach and the iterative predictor approach will be undertaken at Stevens Institute, and will use the computing facilities and such other facilities owned by Stevens Institute as may be necessary.

The technical staff of the Experimental Towing Tank will be supplemented for the purposes of this contract by the employment of one or more members of the Differential Equations Project at Princeton under Dr. S. Lefschets.

2. The experimental studies of the iterative predictor approach and all design and feasibility studies will be conducted by the staff of Askania Regulator Co. at Chicago.

3. The Experimental Towing Tank will provide liaison, coordination, overall administration and direction, and will prepare all reports.

SUGGESTED CONTRACT SPECIFICATIONS

A Task Order under N6onr-247
Initiation date 1 January 1951

MAXIMUM PRICE

as per cost breakdown attached $78000.00

COMPLETION DATE

31 December 1951.

RESEARCH TO BE SUPERVISED BY

Kenneth S. M. Davidson, Director
Experimental Towing Tank
Professor of Mechanical Engineering

EXPERIMENTAL TOWING TANK

STEVENS INSTITUTE OF TECHNOLOGY

Office of Naval Research — Our Proposal of 4 Dec. 1950

ESTIMATED COST BREAKDOWN

	Hours	Rate*	Amount
Engineers	2000	3.15	6300.00
Chief Technical Assistants	2700	1.82	4914.00
Instrument Makers, Machinists, Mechanics, etc.	----	2.00	----
Miscellaneous Laboratory Assistants	3280	1.22	4001.60
			15215.60
Overhead		142%	21606.15
Mathematical Services			3000.00
Travel (principally liaison with Askania at Chicago)			1800.00
Misc. materials and expense including trans. of computing equipment			1400.00
Askania Regulator Co.			35000.00
Total			78021.75

* Average Rates for purpose of this tabulation only

Proposal Rounded to $78000.00

EXPERIMENTAL TOWING TANK
STEVENS INSTITUTE OF TECHNOLOGY
HOBOKEN, NEW JERSEY

DISCUSSION OF A PROPOSAL FOR RESEARCH ON TWO NEW APPROACHES TO CONTROL DESIGN

Our Proposal of 4 December 1950

A control-controlled system, represented by the block diagram of figure (1) is subject to disturbances which may and usually do contain a statistical component. The overall response of the system will depend on initial conditions, the disturbance time history, and the control equation which specifies what action the control takes in all possible situations.

The control problem may be defined in the following way: 1) Find a physically and economically realizable control equation which results in satisfactory overall performance of the system in all operating situations. 2) Find the most economical physical realization of the control equation within the requirements of size, weight, reliability, power requirements, etc.

It is convenient to treat the first or theoretical problem in the terminology of the Game theory of von Neumann and Morgenstern.(1) This part of the control problem can then be discussed as a two player, zero sum game. If we require a limit to the number of plays in a game, the division of 'rewards' at the end of a game is some function of the state of the system. Game follows game instantly, each game determining the initial condition of the next game. A play of the control would consist of a change in the control variable in some small interval of time, and a play of the disturbances would consist of a change in the disturbance in the same small interval of time. Thus, we represent both continuous and discontinuous controls by the same approach, a continuous control being one which is capable of making a large number of plays involving small changes in the variable in a very short period of time. Saturation of rate appears naturally in this scheme: a control variable rate is saturated when over some interval all plays have the same value. See figure (2).

The game may be conceived as starting from some initial conditions, proceeding by alternate plays of the control and the disturbance, toward a conclusion which is defined by the terminal condition.

Then, if we start from some initial condition and explore all possible combinations of plays by both 'control' and 'disturbance', we obtain a set of trajectories which terminate at different states of the system. A value is given to each terminal state. The 'strategy' of the control is best when on each play, it selects the subset which contains the terminal states having the highest aggregate favorable value or score.

However, instead of developing the set of all possible games from its subsets of all possible initial conditions and all possible plays, we can invert the procedure and develop the set of all possible games having the desired terminal state by starting at that point and computing the trajectories for all possible plays backwards in time. This procedure automatically generates all possible initial conditions (terminal conditions in the inversion)

(1) von Neumann and Morgenstern, "Theory of Games and Economic Behavior". Princeton University Press, 1947.

and trajectories in which we are interested and eliminates all plays we would not be interested in.

Every path so generated is, in the forward game, a path from the initial condition to the desired terminal condition. There will be a large number of paths from each initial condition to the desired terminal condition. If we eliminate dummy plays and allow the game to have varying numbers of plays, there is contained in this set a subset having some minimum number of plays from initial to desired terminal condition, hence a minimum time to correct because all plays take the same time. If, on each play, the control selects the 'minimax' play, that is, the play whose branches going to the desired terminal condition, has the lowest value of the maximum number of plays required to reach the desired terminal condition, then no matter what the subsequent plays of the disturbance, the time to satisfy the terminal condition is always no greater than that time, and may subsequently be found to be less.

One may question whether the inverted generation is the same as the straightforward generation of all games, i.e., are these two sets the same set? Clearly, they are not: the inverted procedure generates only the subset terminating at the desired terminal condition. But this is the only set we are interested in, so long as it contains all possible initial conditions, i.e., we would be forced to consider games terminating at points other than the desired terminal point only if we find that no game terminating at the desired terminal point exists for the given initial conditions and control strength. This follows from our 'minimax' strategy: if a play can be selected whose maximum number of subsequent plays to the terminal condition is a minimum, we choose that play. Hence if in a given initial condition there is a play that defines a subset having a finite maximum number of subsequent plays, we always select that in preference to a play that selects a subset having an infinite minimum number of subsequent plays, which is the case when a game never can be played from initial to terminal condition(1). We conclude that generating the set of all relevent games by working backwards from the desired terminal condition is merely a means of reducing the labor of calculation by invoking the minimax strategy in programming the calculations.

In principle at least, the above discussion provides an approach to the first problem: find a control equation which results in satisfactory overall performance of the system.

The suggested approach is:

1) define the duration of a play and the magnitude of a control play in terms of physically and economically realizable 'frequency response' and maximum rate of change of the control variable.

2) define the statistical disturbance in similar fashion, adding if needed any correlations of the probability of a given 'disturbance' play to the occurence of previous plays.

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(1) Since a game terminates on reaching the terminal condition, this game never terminates and, therefore, has an infinite minimum number of subsequent plays.

3) working backward in time from the desired terminal condition at t=0, find all possible games and classify these games by the state of the system at the end of each backward play.

4) select the 'minimax' strategy for all states.

5) find a function of the variables of state F(X, X', etc.) such that if the minimax strategy requires a 'block' play by the control, F(X, X', etc.) >0, and if the minimax strategy requires a 'white' play by the control, F(X, X', etc.)≤ 0. This function is the desired control equation.

If we proceed to a limiting case, the problem can be made so simple as to be amenable to treatment in closed form. (One example of this is worked out in the appendix A of this discussion). Consider the limiting case of no statistical content of the disturbance. Such disturbances arise as commands to change course or attitude or some similar controlled variable. There is no statistical content in the sense that such commands are given to achieve a given condition and are not changed en route to that condition. Then during the correction to the new condition, there is no statistical component.

Assume that we are dealing with a second order linear system, obeying the equation,

$$m\ddot{x} + 2b\dot{x} + kx = \delta, \quad \delta = \pm\delta_o \tag{1}$$

After suitable redefinitions[1], the equation can be replaced by its equivalent non-dimensional system

$$X'' + 2cX' + X = \pm 1 = sgn\, F(X, X') \tag{2}$$

where F(X, X') is the desired control equation.

Suppose that by some design process, an F(X, X') is found which is defined by the condition that all corrections are made in minimum possible time. Then in a control system, we sense X and X' and in some computing network, we generate F(X, X'). When F(X, X')>0 the control variable is made to go positive, while for F(X, X')≤0 the control variable is made to go negative. A system of this kind differs from conventional saturated, bang-bang, or black-white controls only insofar as F(X, X') differs. The distinctive performance of the proposed control scheme is therefore the fact of correcting in minimum possible time, while the distinctive element of the scheme which accounts for the improved performance is the computing network which computes the F(X, X') required for the minimum time of correction instead of some other F(X, X').

There are, in equation (1), four parameters m, b, k, δ_o. However, the nondimensionalizing process reduces this number to one; the damping ratio, c. The F(X, X') required for minimum time of correction is a function of c. If the parameters change from the design parameters m, b, k, δ_o in a way that changes c, a new F(X, X') is required. Since F(X, X') is a complex function of c, it may be difficult to produce an F(X, X') generating network which

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(1) $X = \frac{xk}{\delta_o}$, $\tau = \omega t$, $\frac{k}{m} = \omega_o^2$, $\frac{b}{m\omega_o} = c$, $\frac{dX}{d\tau} = X'$

can be adjusted easily to different values of c. It is therefore desirable to consider other means of finding the switching curve F(X, X'). Before doing so, however, we note that F(X, X') is not an exhaustive solution of the problem of minimum correction time controls; in fact, it applies only to the control of systems desirable by equations (1). A new equation of motion will result in a new switch curve F(X, X',....). As a matter of fact, if the system is described by a third order error equation,

$$a\dddot{x} + b\ddot{x} + c\dot{x} = \delta$$

a switching surface F(X, X', X'') is needed. A fourth order equation would require a switching hyper-surface F(X, X', X'', X'''), and so on. A system with one degree of freedom is usually describable by a second order equation, while a system of two degrees of freedom requires two equations, usually of second order, in two dependent variables. If these two equations are cross-coupled, a fourth order eliminant equation in one dependent variable results, while if there is no cross-coupling, two separate controls of the second order can be used. Furthermore, the equations may not be linear, thus further expanding the range of systems to be developed.

In view of the last paragraph, it is desirable to classify controls according to the differential equations of motion of the system controlled. There will be a separate and distinct computing 'network' for each type of equation of motion.

Historically speaking, the above approach was the second main line of attack to be undertaken. It was presented first in this discussion because a more logical presentation, more closely related to conventional control theory, results from the use of this approach as a bridge from conventional controls to the unconventional propositions we are attempting to expose. However, in all previous discussions, the above approach was classified as II, and we shall so refer to it here, to avoid confusion.

It was pointed out that when parameters of the control or controlled system are changed from the design parameters in such fashion that the non-dimensional equations (those similar to 2) have values of the non-dimensional parameters, like c, which differ from the design value, a new switching function is needed, and it may be very difficult to synthesize a switching function which can be easily revised. There is need for a different approach which permits easy adjustment of parameters. The following will be devoted to one of these approaches.

At any given instant, the control 'needs to know' the answer to one question: 'to switch or not to switch'. If we think of the switching function as a means of building the answer into the control, for all possible combinations of conditions, then it is clear that the reason for the difficulty of non-design parameters is related to the difficulty of representing all of the answers simultaneously. This suggests that parameters could more easily be adjusted in a system that never attempts to answer more than the immediate question, 'switch now?'

Switching, and in fact all control, is undertaken to achieve some condition in the future. Therefore, the question is answered only by knowledge of whether a switch 'now' will lead to the desired condition in the most desirable ways, that is, we need a predictor.

One way of predicting is to try the proposed switch and see what happens. Then, when the future arrives, the answer is known, but the result of the switching has irrevocably occurred as well. An alternative to this is to try the proposed switch on some model in which events happen more rapidly than full scale. If the switch leads to an unsatisfactory answer, there is still time to do something about it. This is what Mr. Ziebolz of Askania Regulator calls the Mississippi River Basin Model approach because the River Model operated by the Army corps of Engineers, at Vicksburg, Mississippi, is the most spectacular example of this approach to predictors in control problems.

In general, there may be more than one switching required to achieve the desired condition. It follows that the desirability of switching 'now' is knowable only when the timing of subsequent switches is known, because the answer obtained in the predictive process will depend on the timing of subsequent switches as well as the 'now' switch.

The problem therefore is to study the response of a model of the controlled system under a variety of switching programs. To do this at all requires it be done systematically. The number and timing of switchings should therefore be adjusted in some systematic fashion after each trial, in terms of the best information available. Such best information consists of three kinds of data:

1) the new initial conditions
2) the switching times of the previous trial, and
3) the extent to which the previous trial failed to satisfy the desired conditions.

When the model scale is such that the ratio of event duration, full scale/model, is very large, the initial conditions can hardly change much from trial to trial except in the case of a change of goal.

We therefore consider only the case of quasi-steady initial conditions. The problem is now to find ways of revising the switching times in terms of the difference between the predicted and desired state as evaluated on previous trials.

If an iterative process of this kind is assumed, we can expect that after some period (which may be long in terms of model event periods, but must be short in terms of full scale event periods), the system will become quasi-steady, the only changes being the small, slow changes in the initial conditions as they are revised at each iteration, and the small resulting changes in switching times. Since the initial condition on each successive iteration was some small distance in the future of the previous iteration, the switching

times should progressively occur earlier in each successive iteration. At some instant a switching time will therefore occur at the instant of starting an iteration. But at this instant both the controlled system and its model are in the same state, hence if that is the correct instant for switching the model, it is also the correct instant for switching the controlled system. This argument provides the means of letting the predictor serve as a control, for it provides the information a control needs - switch now? - in terms of the answers obtained by the predictor.

Clearly, this scheme achieves the desired result of permitting adjustments to allow for changes in controlled system parameters. The adjustment required is the adjustment of the model parameters to correspond to the controlled system. Since we require a very short event period model, an electronic analog representation of the system seems indicated. There are several variations of these schemes, such as the analog computer, the shaped pot analog (which gives its answers instanteously), and others.

We thus arrive at the two main lines of approach shown schematically in figures (3) and (4). The essential features of the scheme just discussed (Scheme I) are:

1) the use of a predicting analog of the controlled system,

and

2) the rules of iteration whereby the predictor is made to converge on solutions having specified limit performance characteristics; while the essential feature of the previously discussed Scheme II is the selection of a particular non-linear function $F(X, \overline{X'}$, etc.) which represents all limit solutions characterized by minimum time of correction.

The non-linear scheme may be much more compact and simple than the analog-predictor scheme, while the analog-predictor scheme may be easier to apply to higher order systems or systems with variable coefficients. Both should be developed.

The program of research, leading to the development of such limit controls as are described above, will therefore be concerned with two approaches:

I The analog-predictor or 'Mississippi River Basin Model' approach, and

II The non-linear function approach.

Under both approaches, it will be desirable to consider the idealized case of no statistical disturbances as a limiting case which, practically speaking, corresponds to a 'maneuvering' control rather than a 'course-keeping' control. It is obviously desirable to investigate performance in the presence of statistical disturbances. Some of the problems, such as the definition of switching curve functions can be handled theoretically, in certain idealized cases, more expeditiously than in any other way, while when non-linear systems are being studied, the most practical approach to design is by computing solutions. Theoretical studies will also serve as a guide to computing programs dealing with more difficult cases.

The 'Mississippi River Basin Model' approach is not very amenable to theoretical treatment or to computation by ordinary techniques, especially when statistical disturbances are to be considered. There should therefore be a program of research in which such controls are simulated, using together a fast computer to simulate the highspeed analog in the control and a slower computer to simulate the controlled system.

The researches should deal with one practical control problem from the beginning, so that its results can be evaluated in an actual application at the earliest possible date.

The proposed research is therefore expected to embrace:

I The two approaches
   - A) Scheme I, 'Mississippi Model' systems.
   - B) Scheme II, non-linear control functions, and their variants.

II Two classes of problems
   - A) A practical control problem.
   - B) A group of idealized systems for theoretical study.

III Two kinds of disturbances
   - A) Pure maneuvering, command disturbances.
   - B) Statistical, noisy disturbances.

IV Two principal goals
   - A) Definite answers regarding feasibility of the various above approaches and variations as controls for the selected practical application.
   - B) 'blocking out' the
     1) best rules of iteration for various systems under Scheme I, and
     2) the non-linear, switching functions F(X, X', etc.) for various 'mathematical systems'.

To provide the desired skills for the various phases of the above researches, the Experimental Towing Tank proposes to: 1) secure the services of one or more members of the Differential Equations Project under Dr. S. Lefschetz at Princeton to do much of the theoretical work, and 2) subcontract to Askania Regulator Co. certain phases of the work primarily concerned with feasibility studies and the practical application. The Experimental Towing Tank will provide liaison, coordination, overall administration and direction, and will undertake most of the computing phases of the research.

APPENDIX A
ANALYTIC DEVELOPMENT OF SWITCHING FUNCTIONS.

Consider again the equation of motion

$$X'' + 2\alpha X' + X = \pm 1$$

Rearranging and integrating over a small time interval τ

$$X'' = \pm 1 - 2\alpha X' - X$$

$$(\Delta X') = X''\tau = (\pm 1 - 2\alpha X' - X)\tau$$

$$(\Delta X) = X'\tau = \left(X' + \frac{\Delta X'}{2}\right)\tau$$

Start at a point X_o, Y_o , $Y = X'$ and traverse a path X_o, $Y_o \rightarrow X_1$, $Y_1 \rightarrow X_2$, $Y_2 \rightarrow X_3$, $Y_3 \rightarrow X_4$, Y_4 letting $\tau_{1,2,3,4}$ be undetermined, using the + sign from X_o Y_o to X_1 Y_1 and from X_2,Y_2 to X_3,Y_3, and the - sign from X_1,Y_1 to X_2,Y_2 and from X_3,Y_3 to X_4,Y_4.

Set $X_4 = X_o$, $Y_4 = Y_o$, so that the path is closed. Actually, such a path is physically impossible because a part of the path would have to be traversed in a negative time interval. But it is equivalent to two paths going from X_o, Y_o to X_2, Y_2, one by way of X_1 Y_1 and the other path going through X_3, Y_3.

The resulting equations are solved for the difference in time by the two routes, i.e., for $\Delta\tau = \tau_1 + \tau_2 - \tau_3 - \tau_4$. Higher order terms can be dropped since we shall let $\tau_1 + \tau_2 \rightarrow 0$. Then if $\Delta\tau < 0$, $\tau_3 + \tau_4 > \tau_1 + \tau_2$ and it takes longer to go by way of X_3, Y_3 than by way of X_1, Y_1.

Looking at the paths as a closed loop, when $\Delta\tau < 0$, there is a net gain in time by traversing the loop in the $X_o \rightarrow X_1 \rightarrow X_2 \rightarrow X_3 \rightarrow X_o$ direction.

Suppose now that we proceed to a limit of $\tau_1 + \tau_2 \rightarrow 0$. The path becomes infinitesimal and is 'located' at X_o, Y_o. We then map the regions in which $\Delta\tau < 0$ and those where $\Delta\tau > 0$. A dividing line $\Delta\tau = 0$ will be constructable in the X, Y plane.

Some part of the plane near the origin might look like figure 5. If we want to go from a position X_1, Y_1 to 0,0 in minimum possible time, various paths are physically possible, but throughout the $\Delta\tau < 0$ region, time is saved by holding the + sign first in proceeding from any one point to any possible neighboring point. Since this is true for all paths in the region between the point X_1, Y_1 and 0,0, we should hold the + sign first, and continue to hold it until:

a) The line $\Delta\tau = 0$ is encountered, or

b) It is no longer possible to get to 0,0 by holding the + sign.

In either contingency, the switch to negative sign should be made.

Figure 6 shows a group of adjacent small paths. If $\Delta\tau<0$ for all, which is to say that time is saved by taking the + sign first, then since the common paths cancel just as in the derivation of Stokes theorem (which will be the model for a rigorous treatment), the time saved in going from A to B by holding + until C is reached and then going to the - control sign is the sum of the savings around each loop in the same sense.

This approach, only schematically outlined, provides a general method for the determination of switching curves and for proofs of statements previously made intuitively regarding the desirability of saturation. Its relation to the 'plays' of a game theory approach are obvious. Where before, we considered a variable number of plays of equal duration, in this scheme we have a fixed number of plays from X_1, Y_1 to 0,0 but of variable duration.

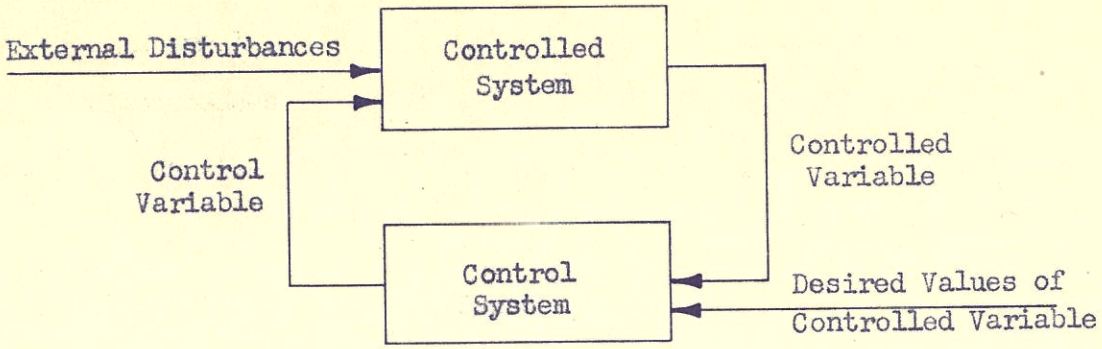


FIGURE 1

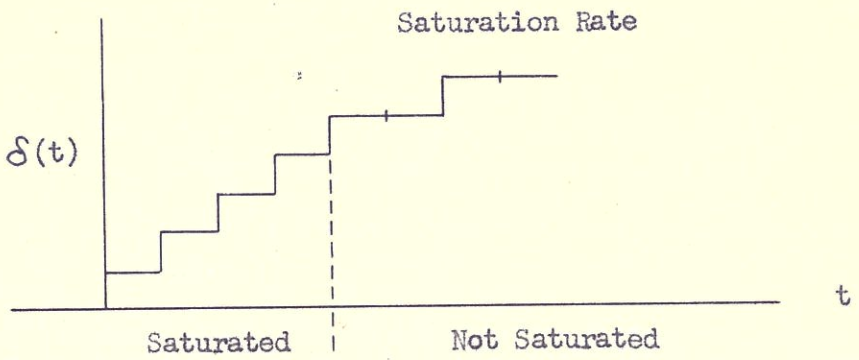
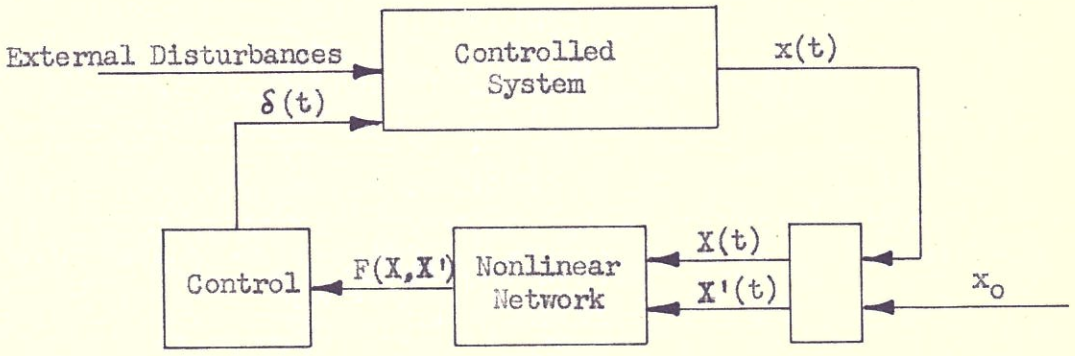
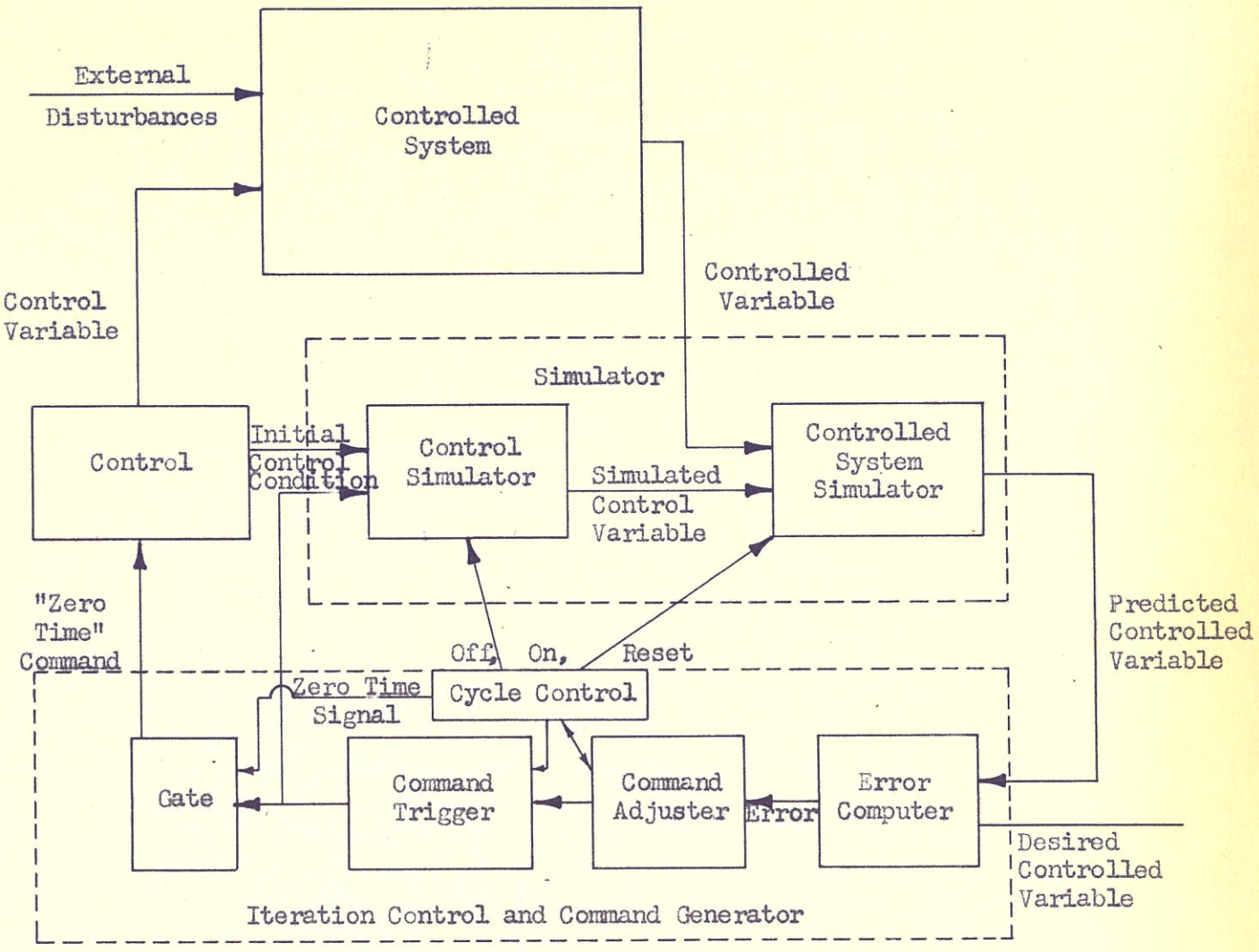


FIGURE 2



Scheme II

FIGURE 3



Scheme IA ("Fast Time" Analog Predictor)

FIGURE 4

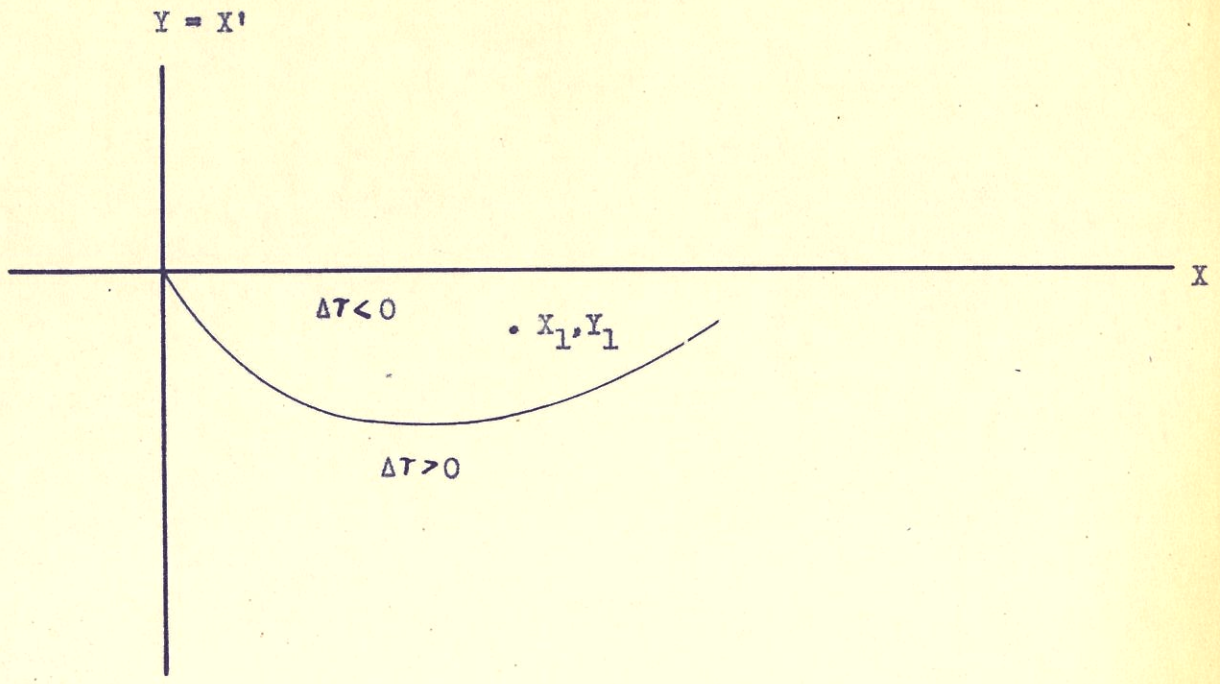


FIGURE 5

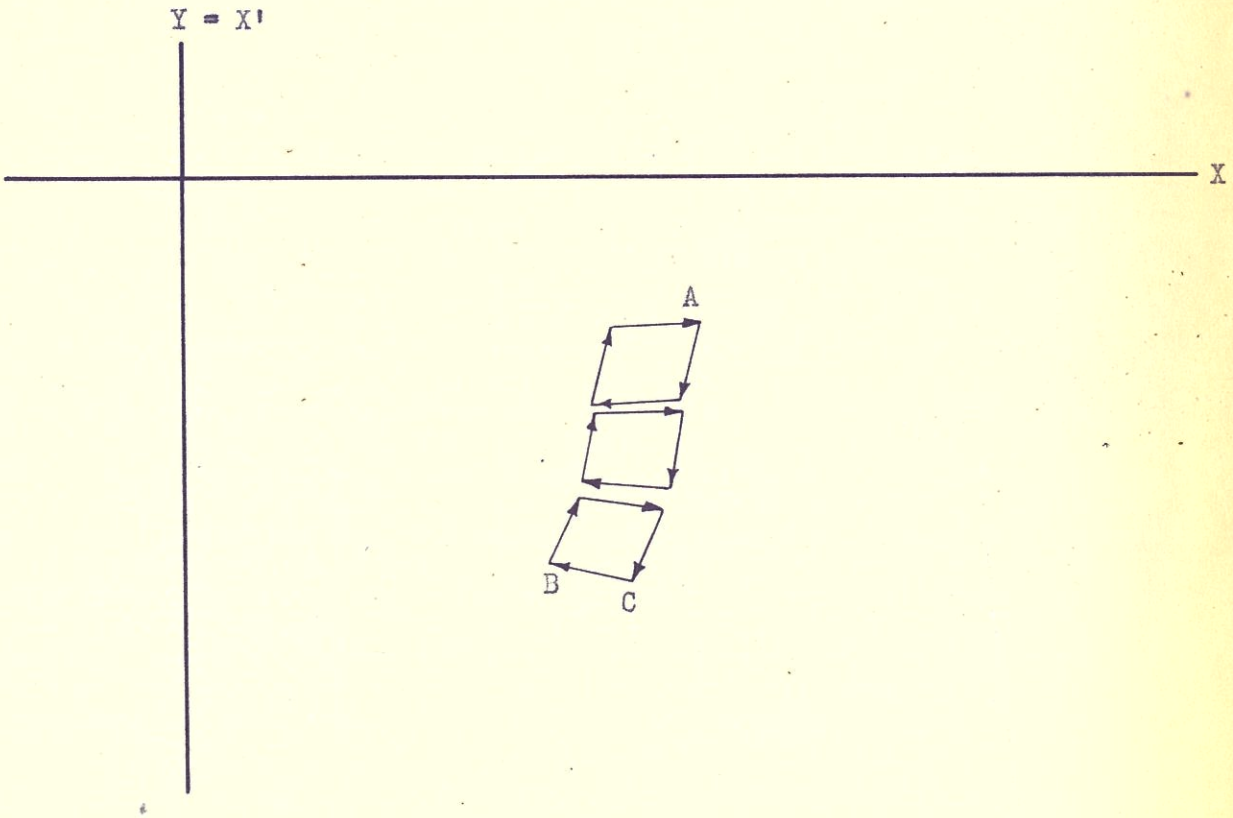


FIGURE 6